

# HAZUS-MH and Dam Inundation



# Objectives

Introduction to HAZUS-MH

Flood Information Tool (FIT)

HAZUS Output

HAZUS-MH Support Network

HAZUS Training

# History

Program initiated in 1992

Earthquake model versions developed in 1997, 1999, 2000, 2001, 2002, 2005, 2006, and 2007

Development of Hurricane and Flood models initiated in 1998

Multi-hazard HAZUS (HAZUS-MH) with models for hurricane, flood and earthquake hazards released in Spring 2004

HAZUS-MH Maintenance Releases in Jan. 2005, June 2006, and June 2007

# What is HAZUS-MH?

GIS-based tool used on a personal computer

Available from FEMA free of charge

(<http://www.fema.gov/plan/prevent/hazus/>)

Requires installation of ArcGIS 9.2, ArcGIS Spatial Analyst 9.x (for flood modeling), and applicable ArcGIS service packs



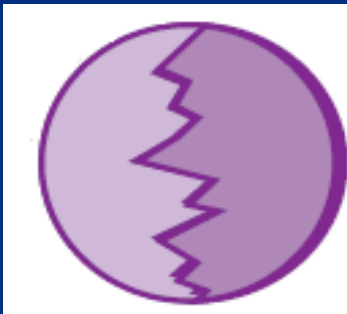
# Supported Hazards



**Hurricane Winds**

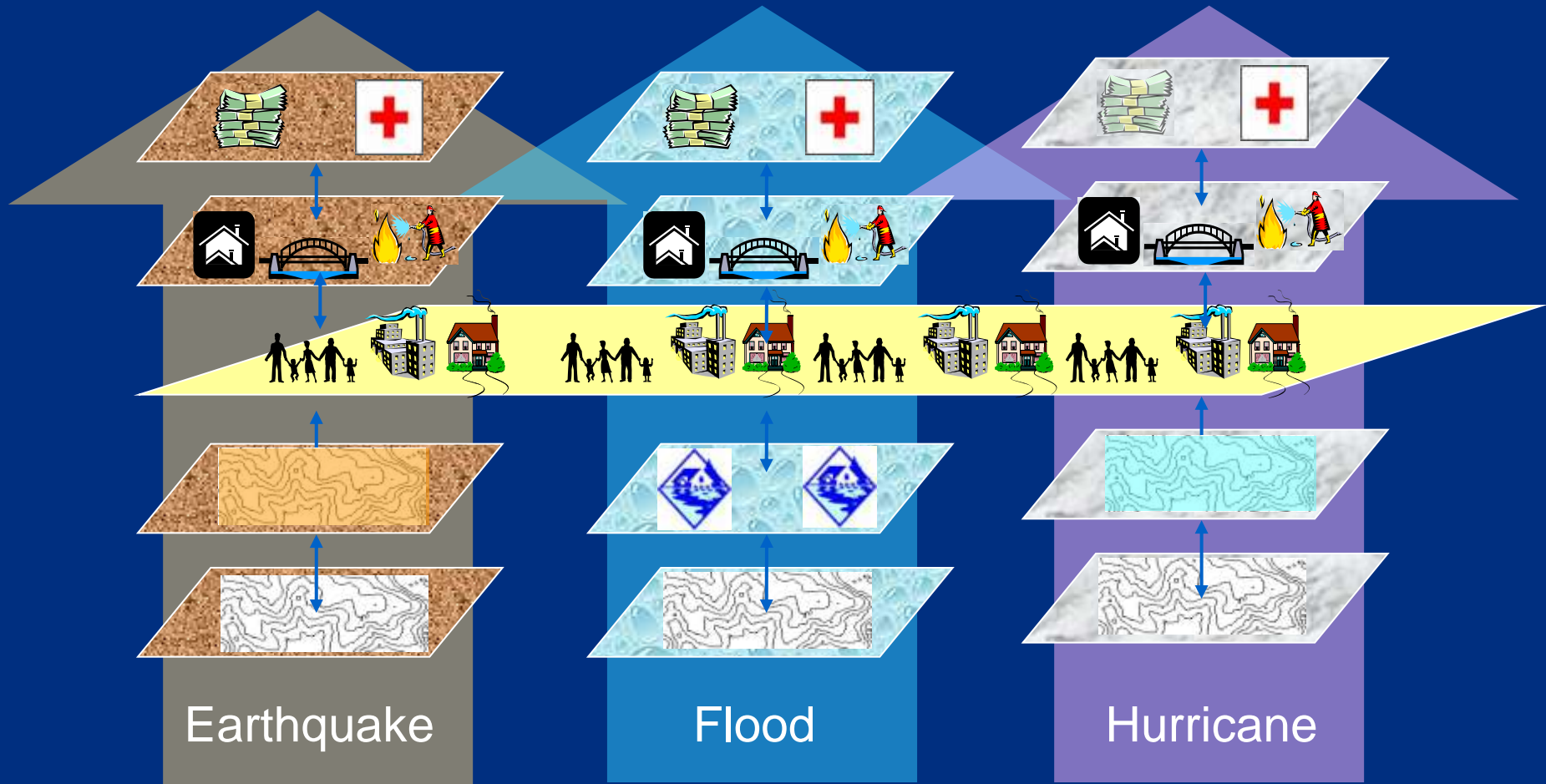


**Riverine and  
Coastal Floods**



**Earthquakes**

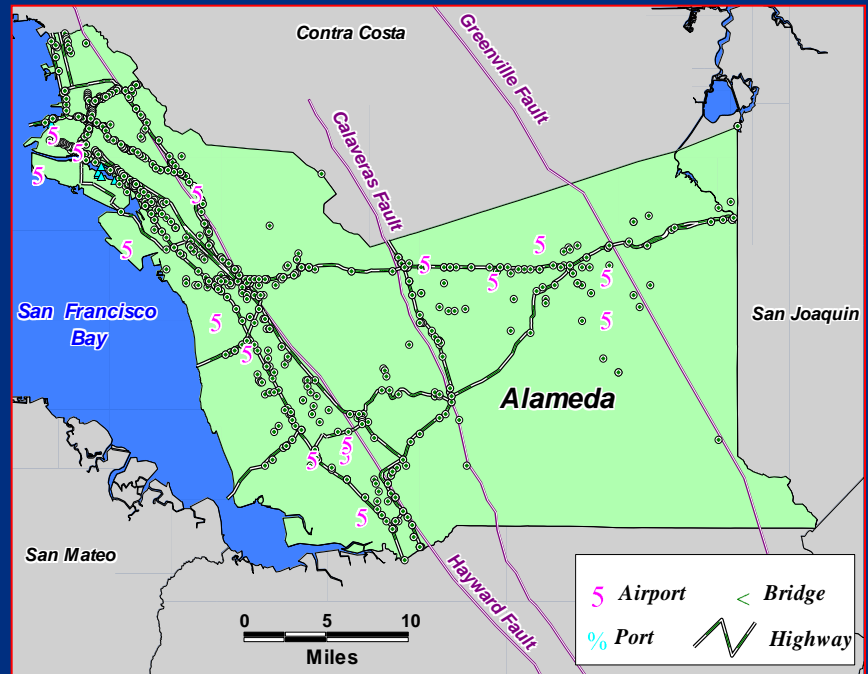
# How does HAZUS-MH estimate losses?



# Inventory (Exposure) Data

HAZUS-MH provided data:

- Common to all hazards
  - General building types and occupancies
  - Lifelines
  - Replacement costs
  - Demographics
- Hazard-specific
  - Specific building types
  - Elevation
  - Building configurations



# Tools for Integrating Local Data

## Data Integration Tools

- Building Import Tool (BIT)
- Flood Information Tool (FIT)
- Comprehensive Data Management System (CDMS)

## Linkage to third-party Models

- Areal Locations of Hazardous Atmospheres (ALOHA)
- Flood Waves (FLDWAV)

NOTE: These tools are covered in advanced courses



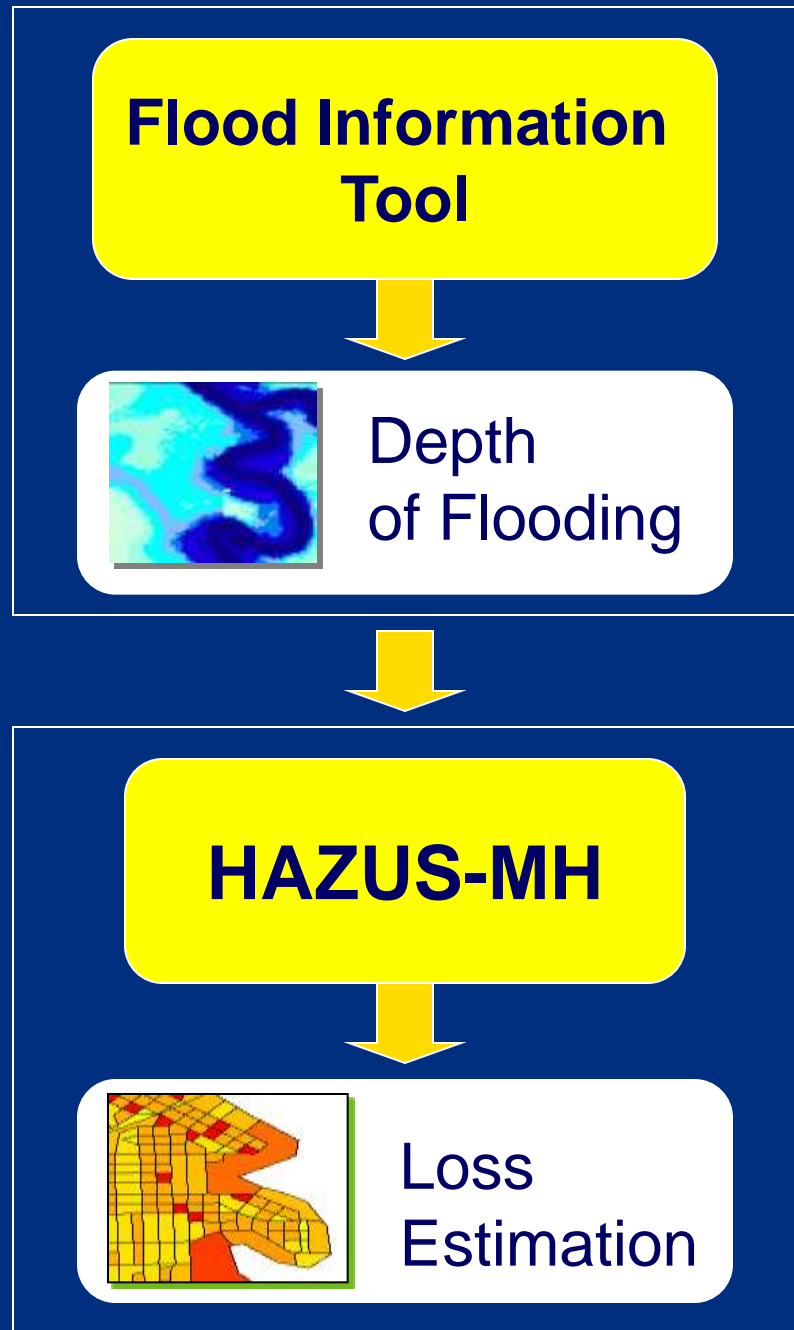
# Flood Information Tool (FIT)

# What is the Flood Information Tool (FIT)?

System of tools that generate a floodplain based on user provided input

Input sources

- Flood engineering reports
- User-run models



# Key FIT Functionality

Validation of input spatial data

Development of flood elevation and depth grids

Analysis of non-conveyance areas

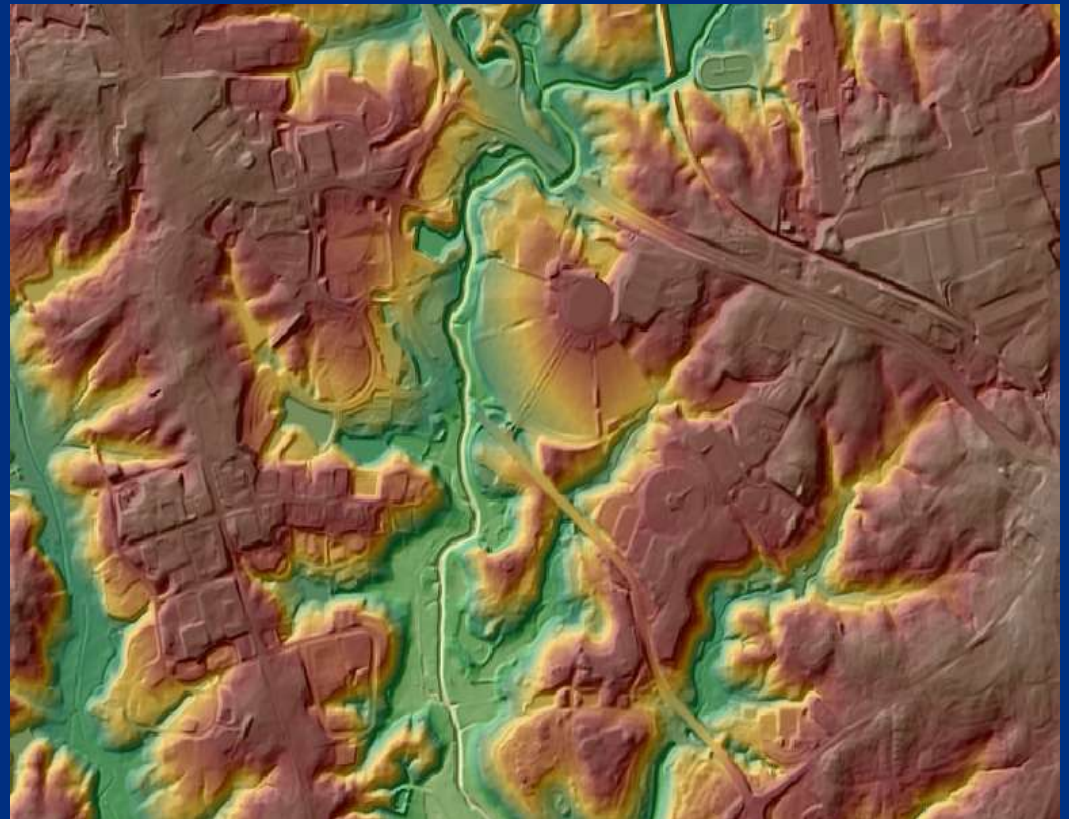
Interpolation of grids for return periods not included in input data

# Required Input Data

## Terrain (Digital Elevation Model)

ArcInfo grid processed  
to bare-earth  
conditions

Tutorials aid in  
conversion of various  
topographic data (spot  
elevations, contours,  
TINs) to the grid  
format



# Required Input Data

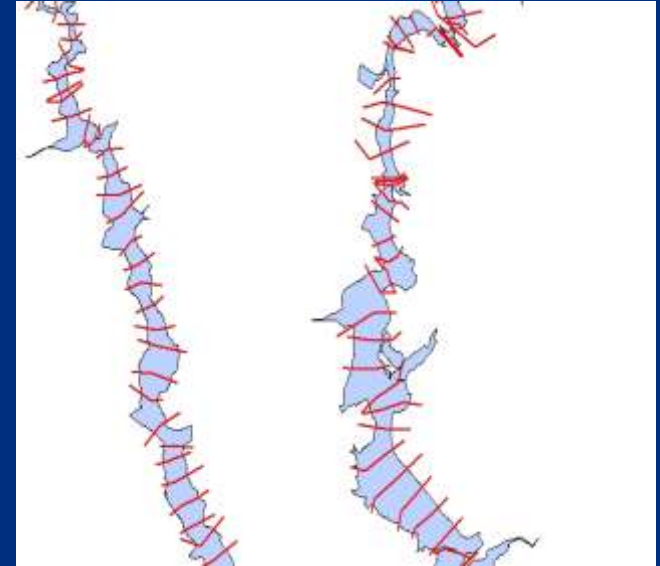
## Flood Elevation Cross Sections

Line feature class

Cannot intersect each other, but should intersect floodplains

Must be attributed with flood surface elevation for desired return period

Discharge values are not used except for interpolating additional flood depth grids



Attributes of Cross_Sections							
	EL_100_YR	EL_500_YR	Q_2_YR	Q_10_YR	Q_25_YR	Q_50_YR	Q_100_YR
	606.11	608.05	3792	7006	8053	9887	11246
	606.48	608.3	3792	7006	8053	9887	11246
	607.71	609.7	3792	7006	8053	9887	11246
	608.58	610.76	3792	7006	8053	9887	11246
	609.71	612.21	3792	7006	8053	9887	11246
	608.58	610.76	3792	7006	8053	9887	11246
	609.71	612.21	3792	7006	8053	9887	11246
	610.87	613.4	3792	7006	8053	9887	11246

Record: 0 Show: All Selected Records (0 out of 159 Selected.) Options

# Required Input Data

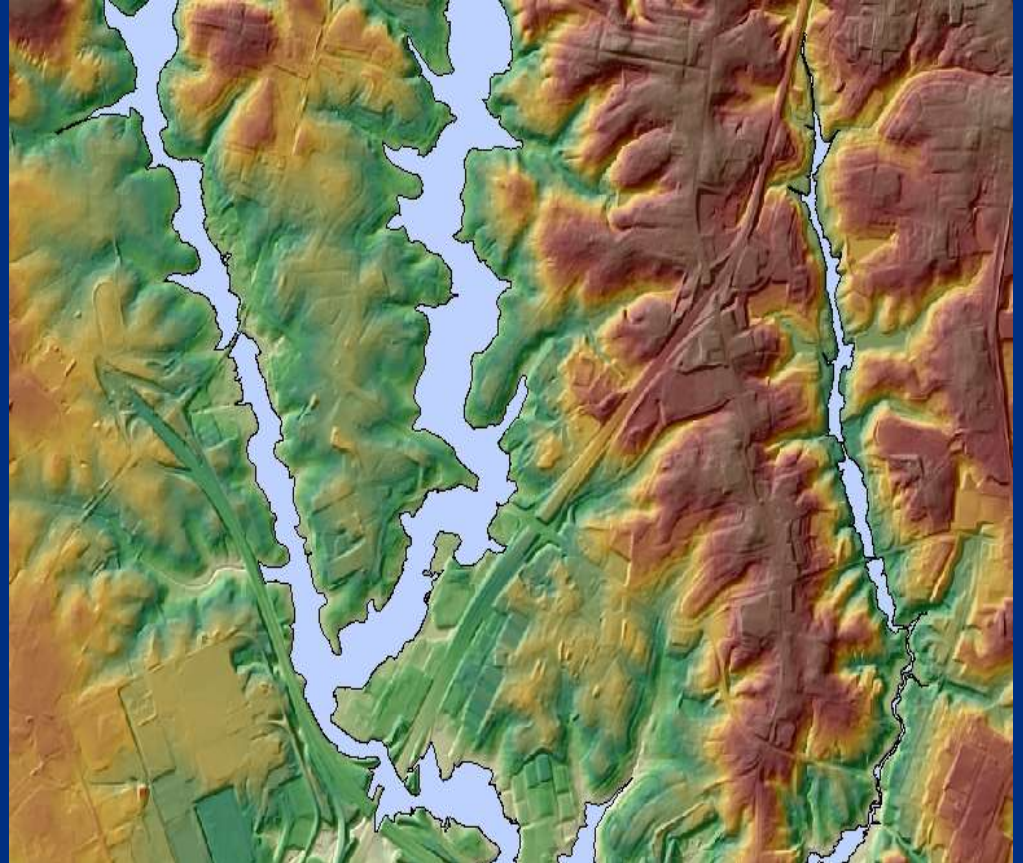
## Floodplain Analysis Boundary

Polygon feature class

Must be single  
contiguous polygon

Helps define the limits  
of analysis

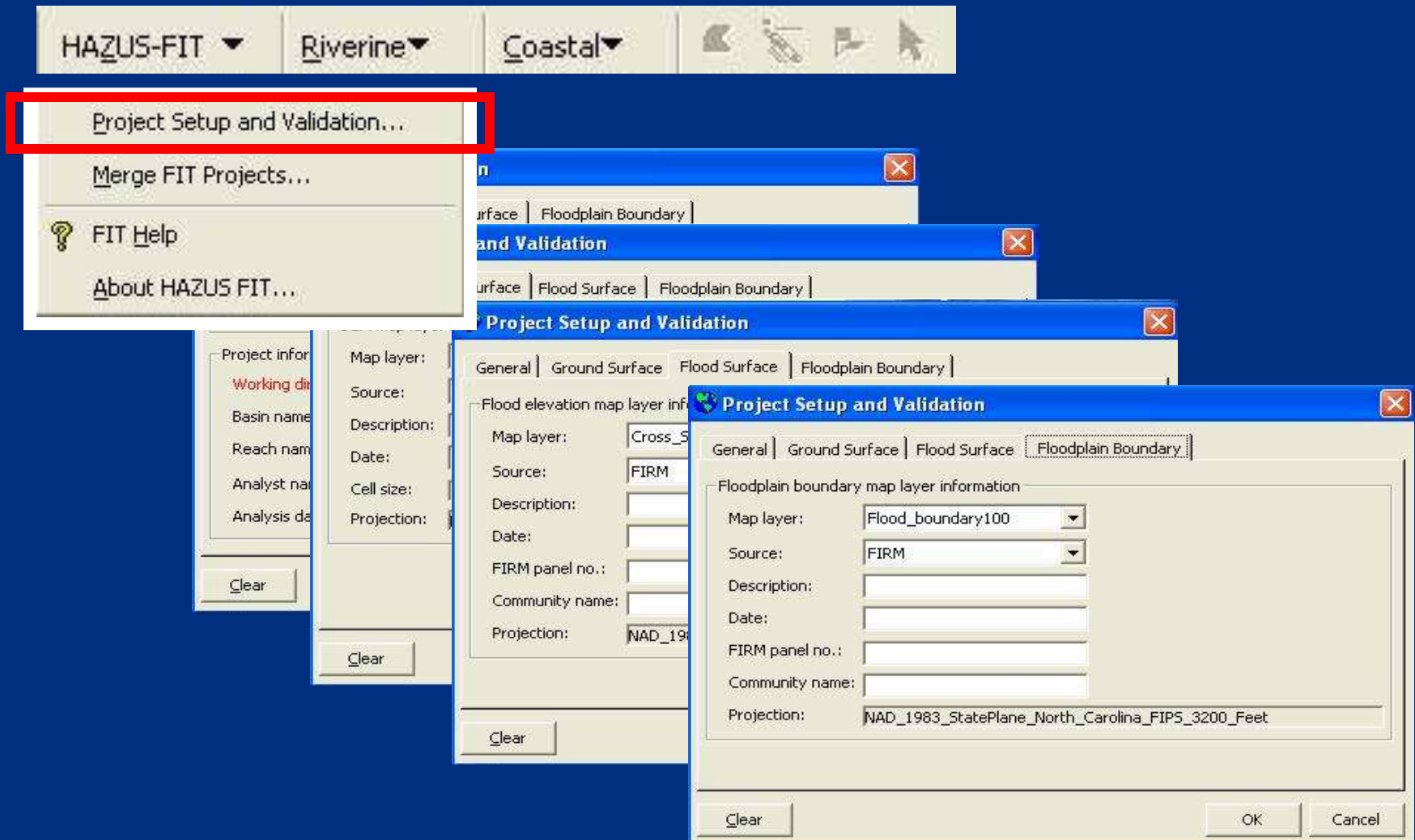
Potential sources:  
DFIRM, Q3





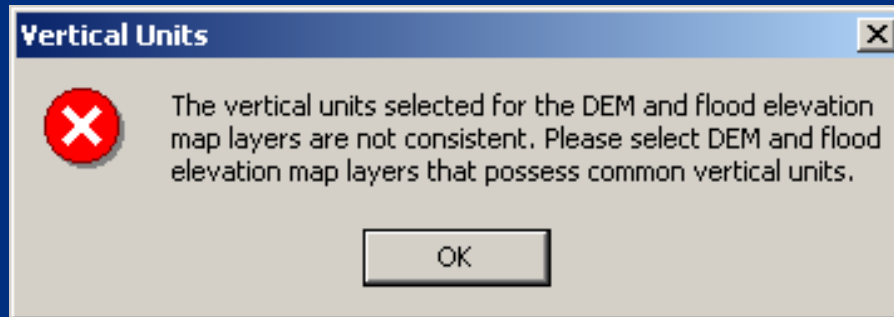
# Project Setup & Validation

User is prompted to identify input data



# Project Setup & Validation

## Validation Error Alerts



Checks user input for required fields

Verifies consistency



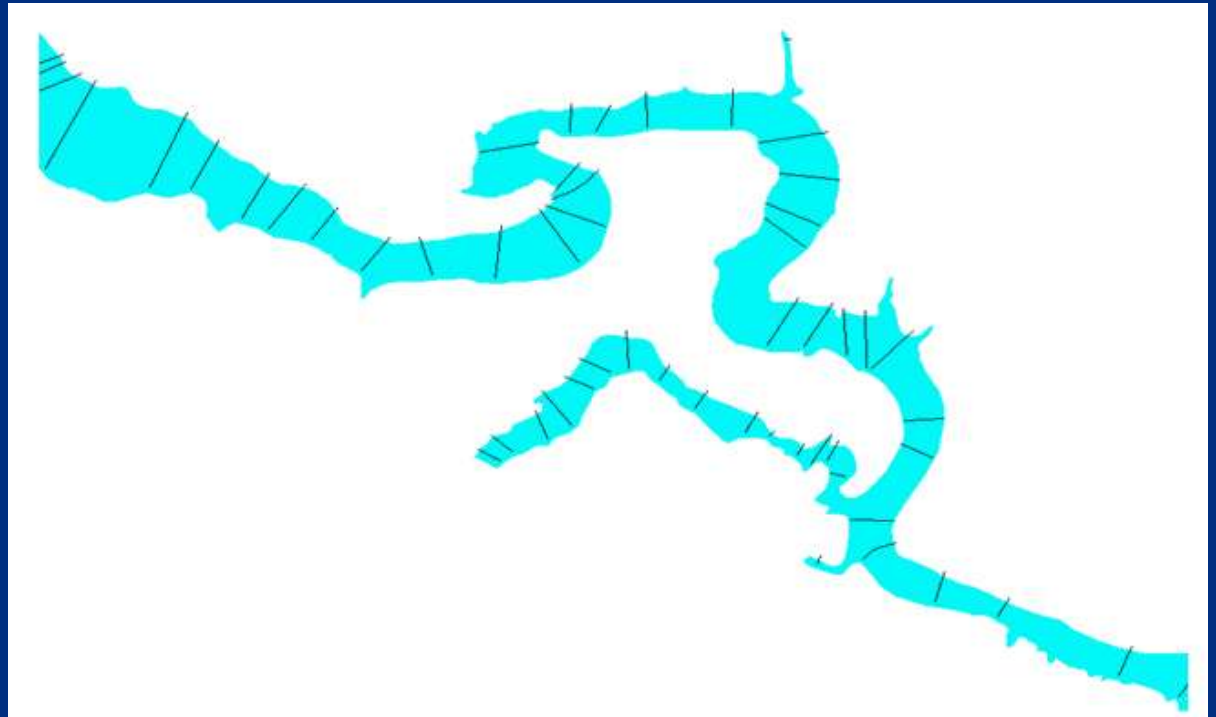
Successful validation allows enabling of analysis menu items



# Flooding Mechanisms

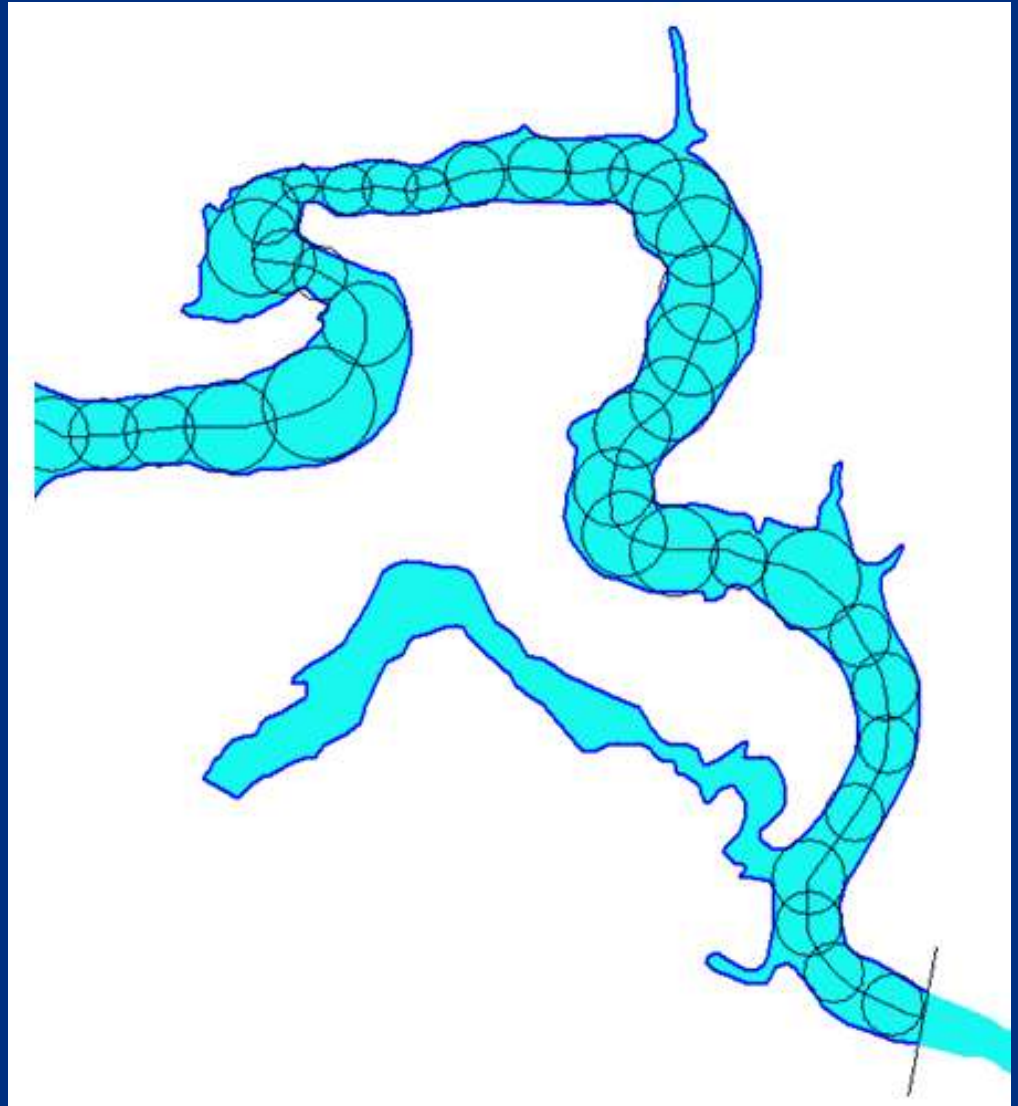
Conveyance – water flows upstream to downstream, flood elevations decay between adjacent cross sections

Backwater – water backs up from the main channel to a tributary or low-lying area



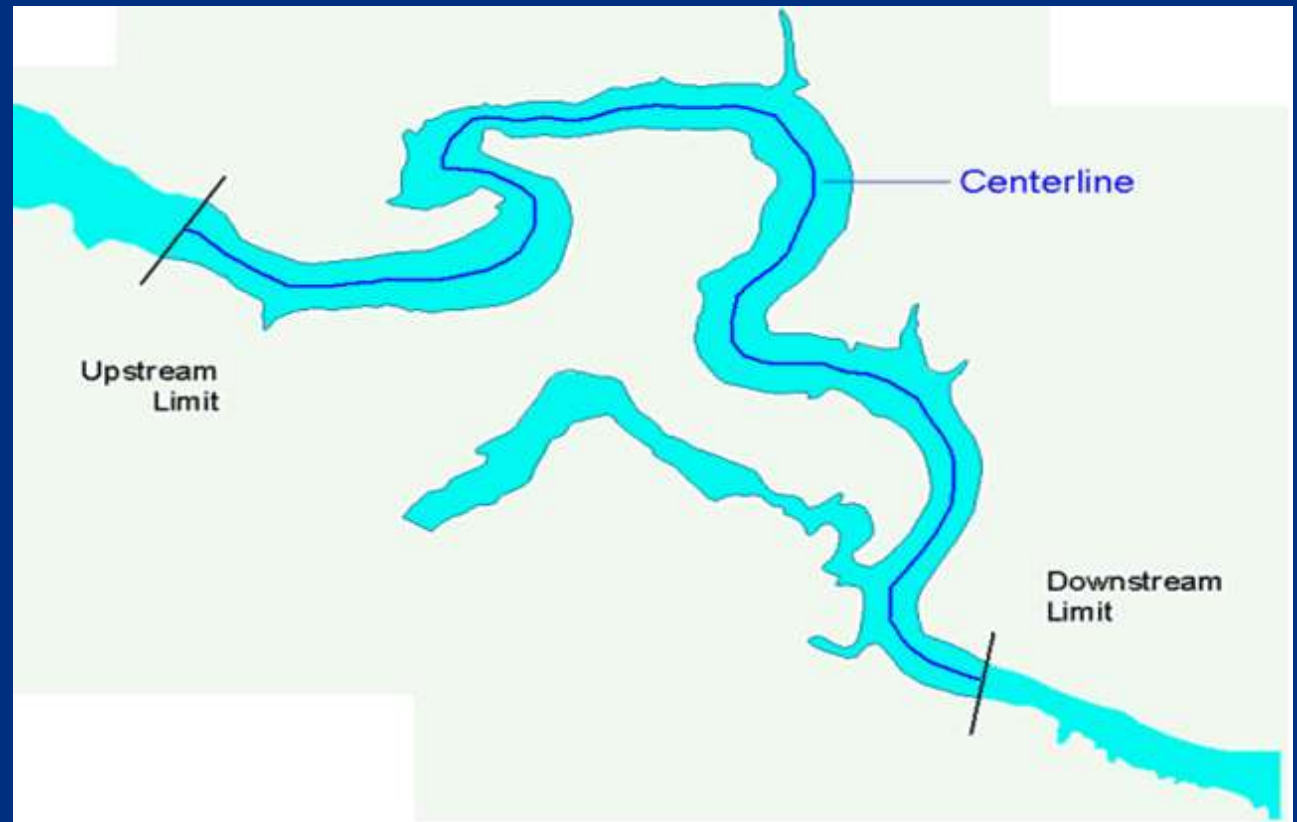
# Centerline

“Ball” expands and contracts along flood plain boundary in conveyance areas



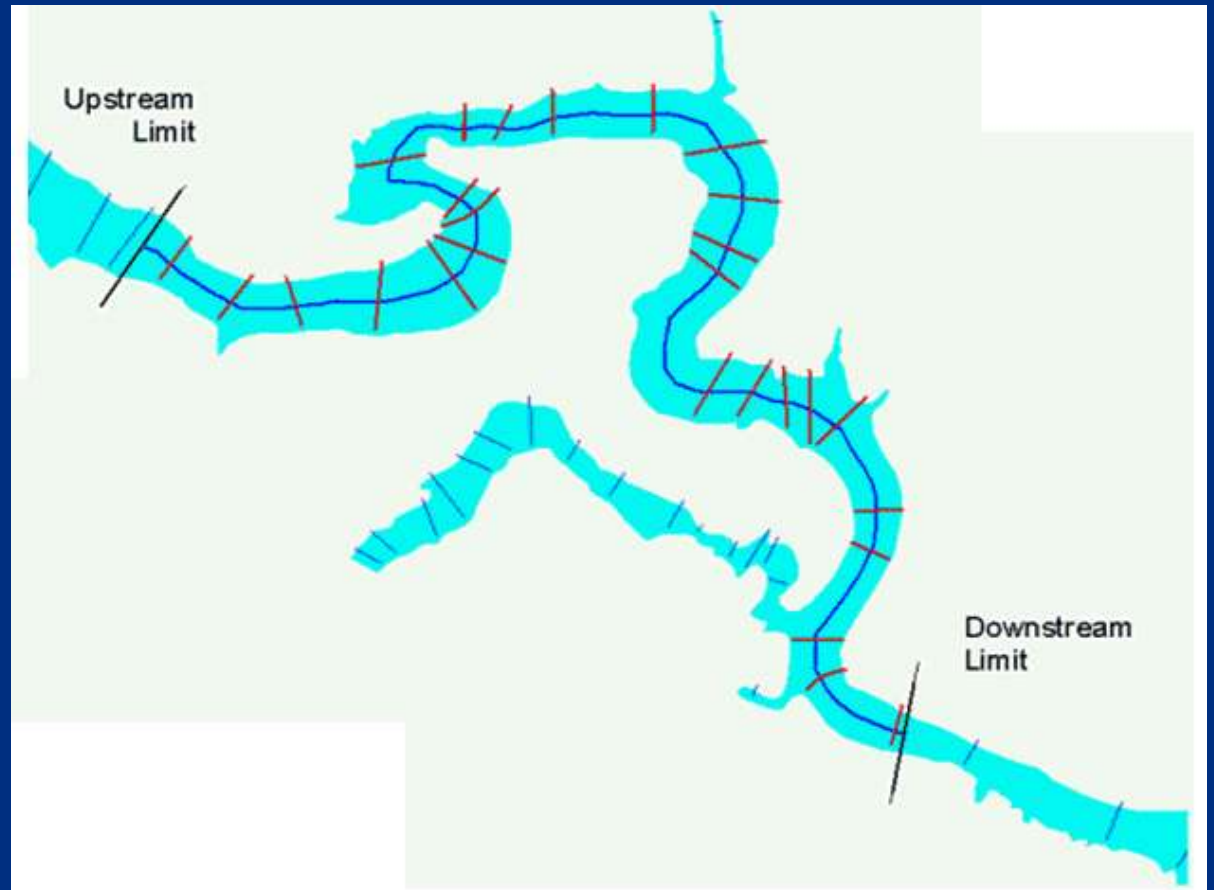
# Centerline

Centerline represents the center of the floodplain, not the center of the stream.



# Cross Sections

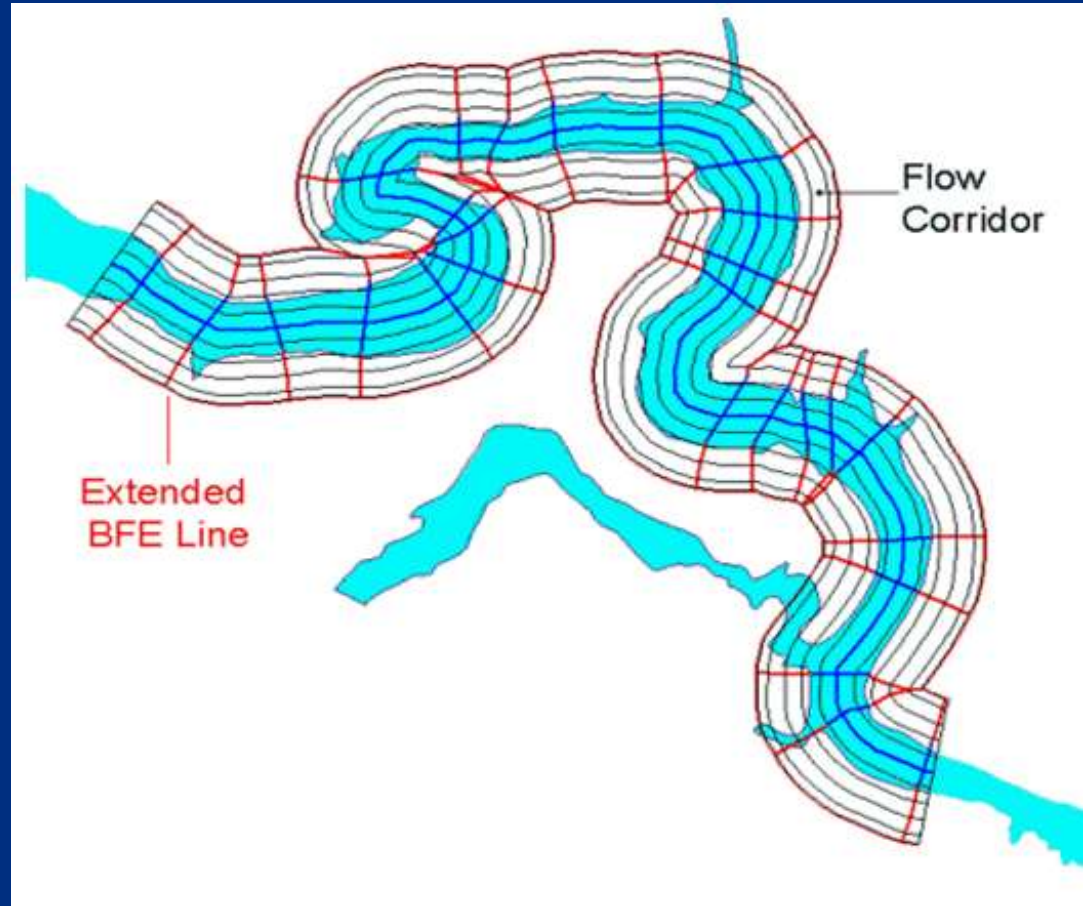
In FIT, you can define your own upstream and downstream limits to tailor your study area.



# Cross Section Extension

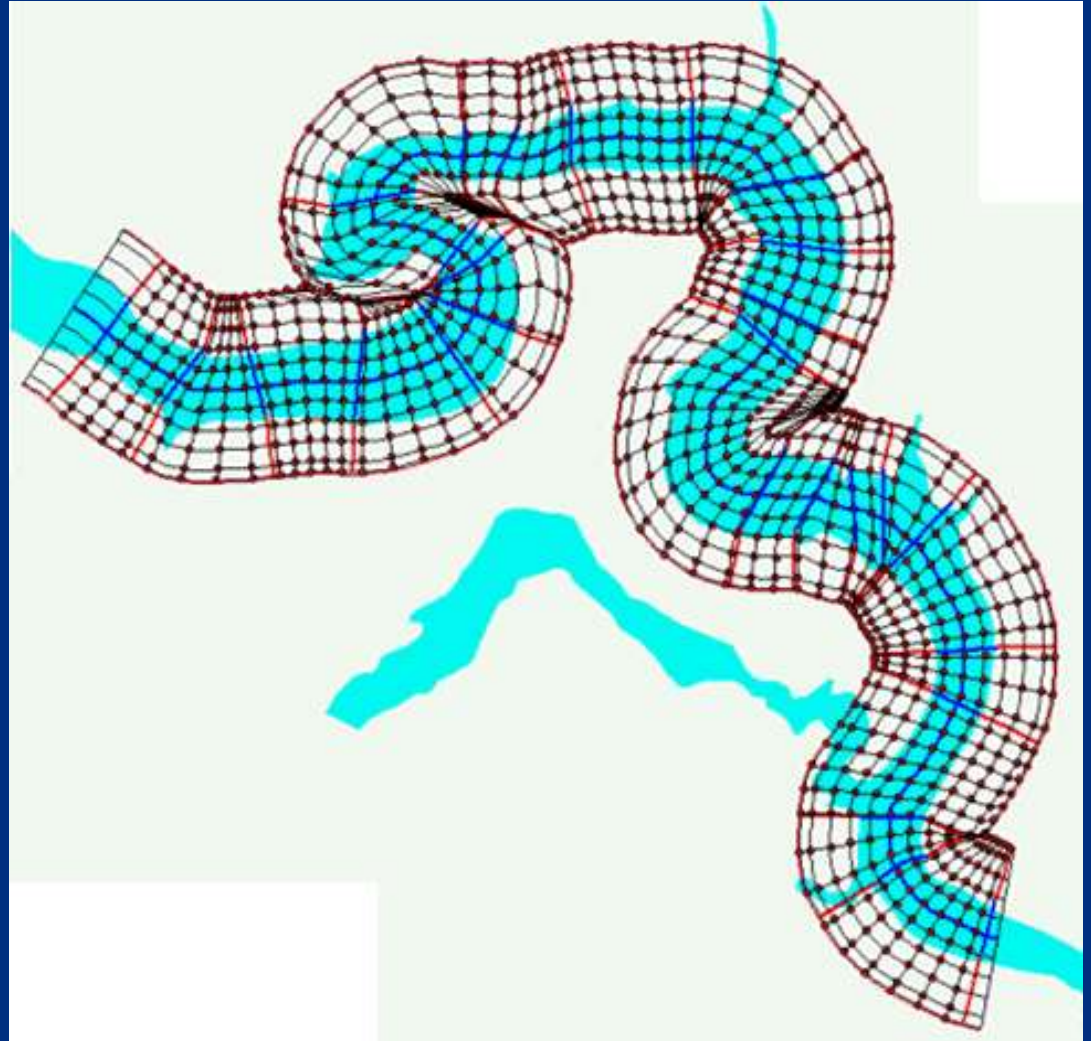
A series of buffers is created between the centerline and the bounding polygon.

Cross sections are extended to bounding polygon if necessary.



# Flood Elevation Points

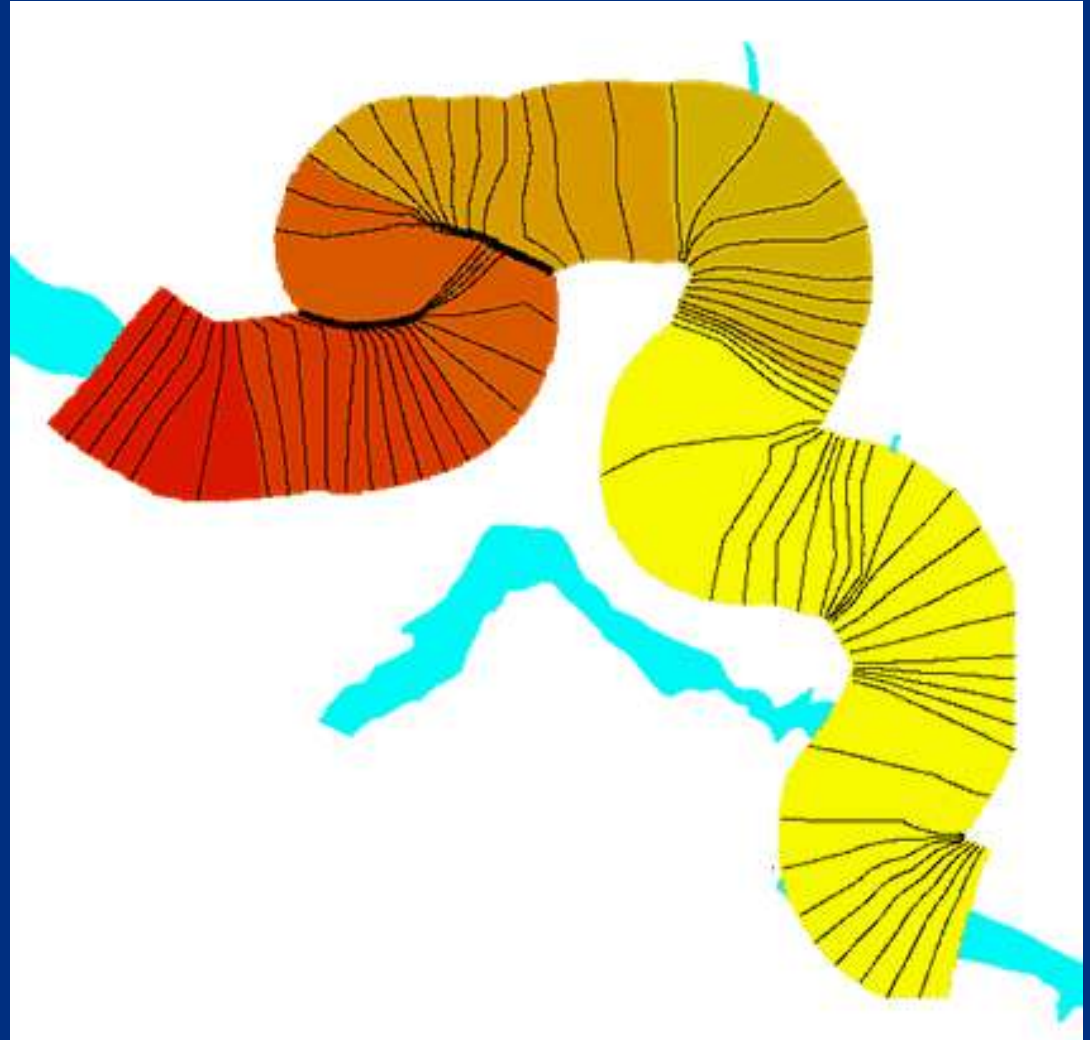
Flood elevation points at regular intervals are interpolated between cross sections.





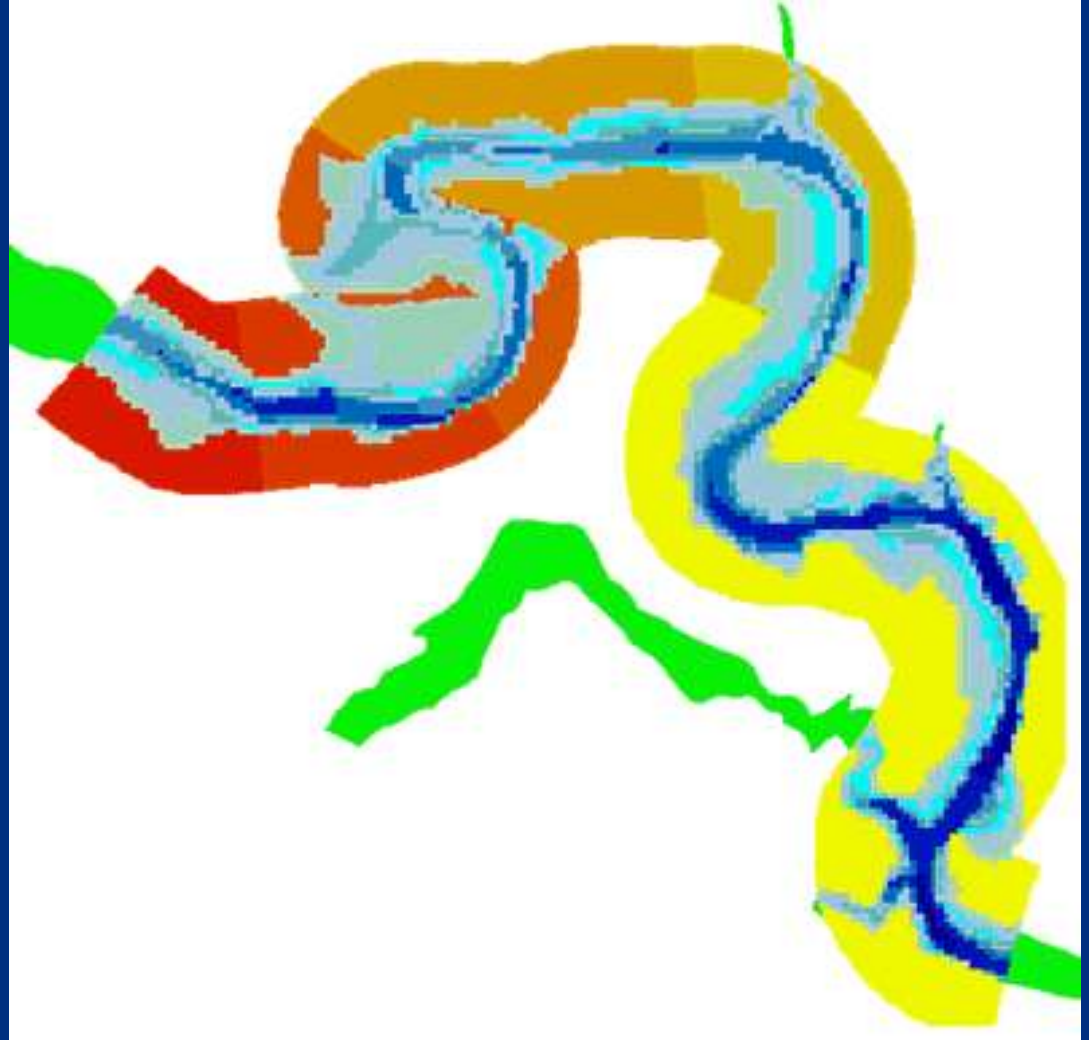
# Flood Elevation Grid

Flood surface is interpolated from elevation points.



# Flood Depth Grid

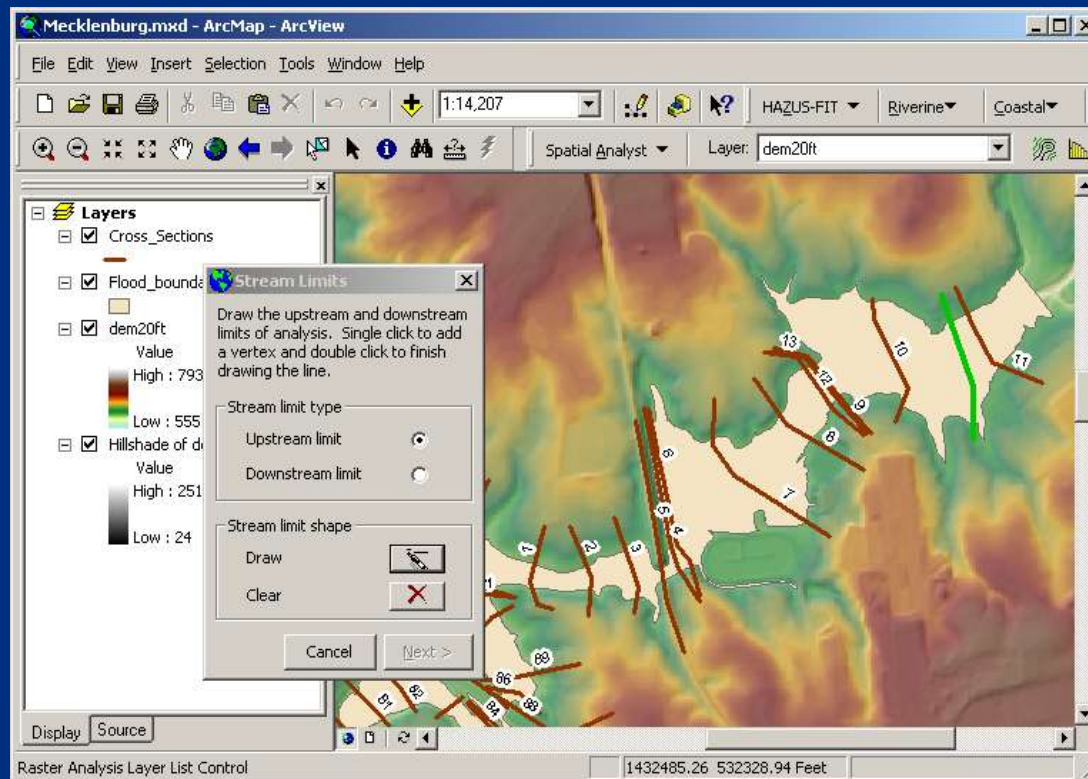
Flood depth grid =  
flood surface -  
ground elevation.





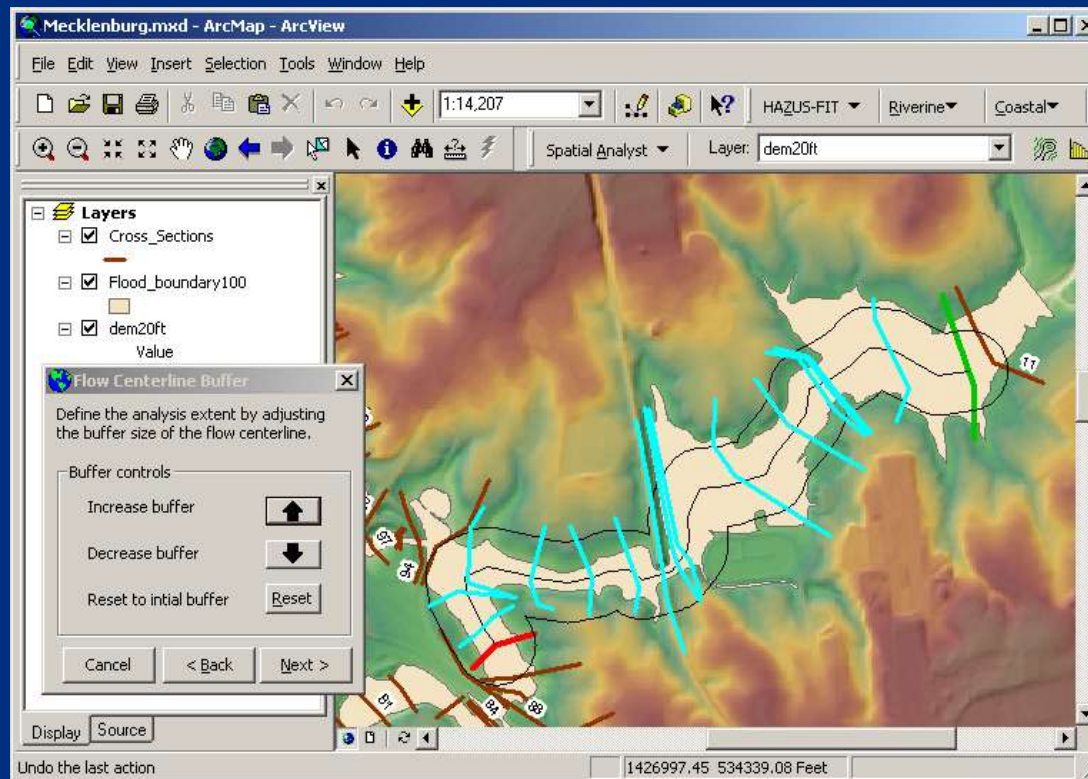
# Depth Grid Wizard

Stream Limits Dialog is used to identify the upstream and downstream limits of the study area.



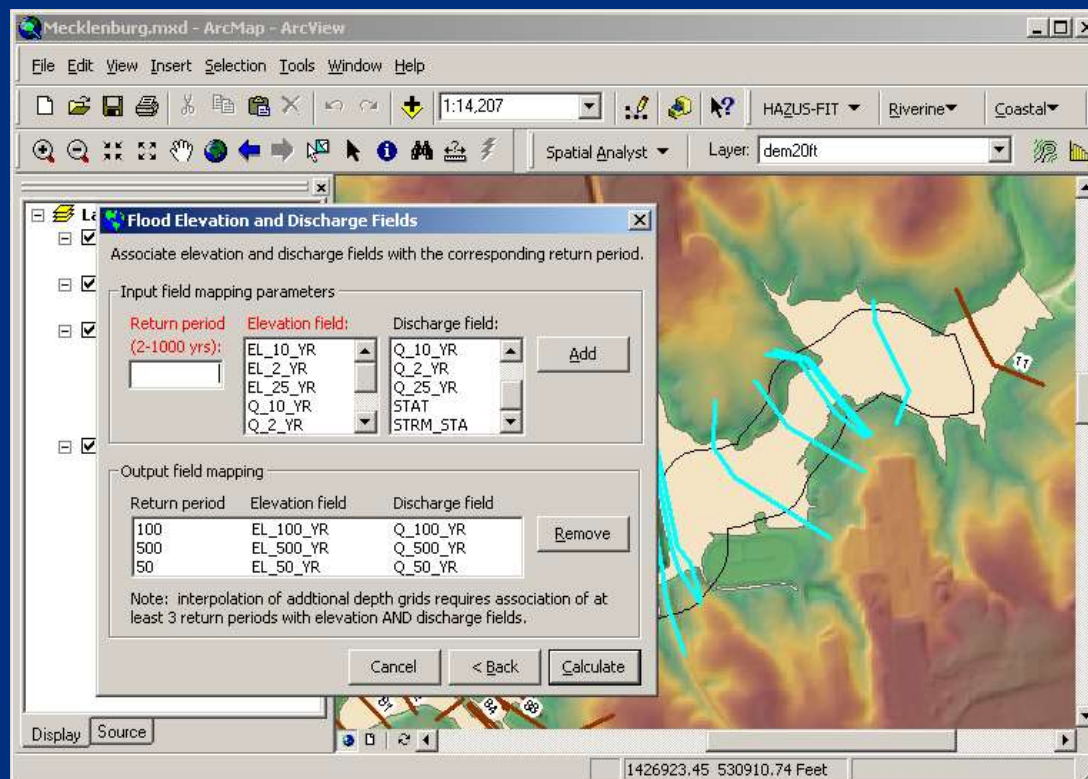
# Depth Grid Wizard

Centerline buffer captures area of conveyance.



# Depth Grid Wizard

Associate flood elevation and discharge fields with return period.

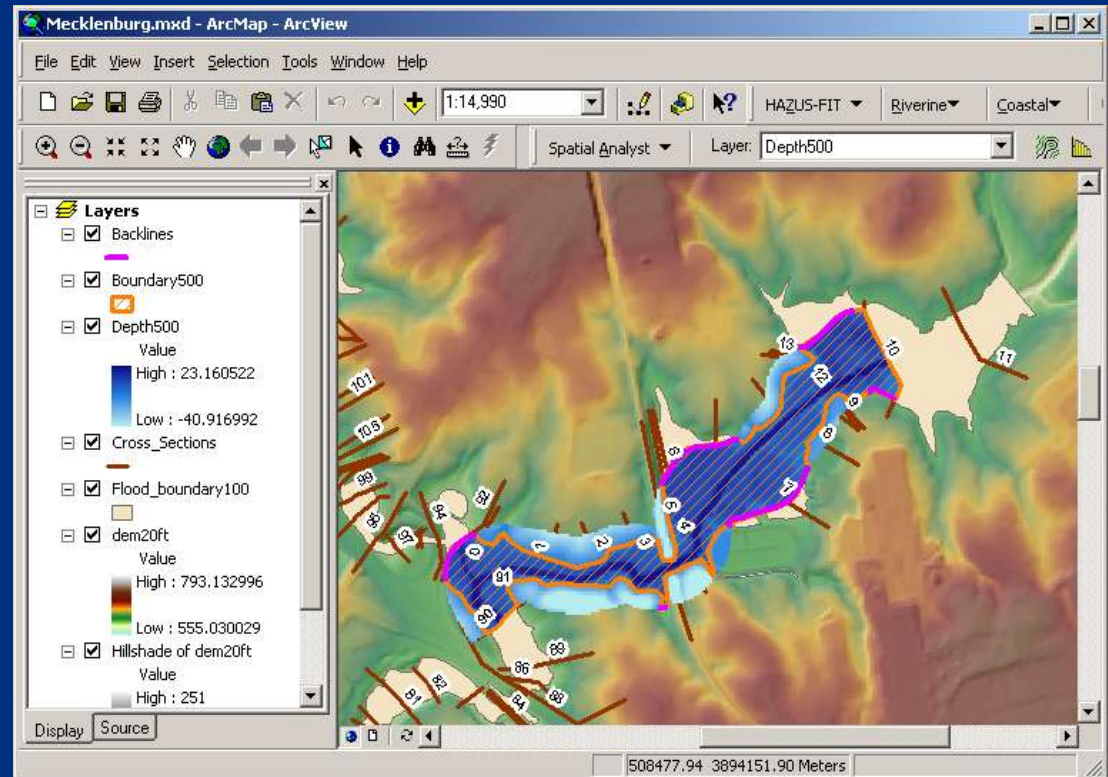


# Depth Grid Wizard Output

# Depth Grid

# Flood boundary

## Backlines (if needed)



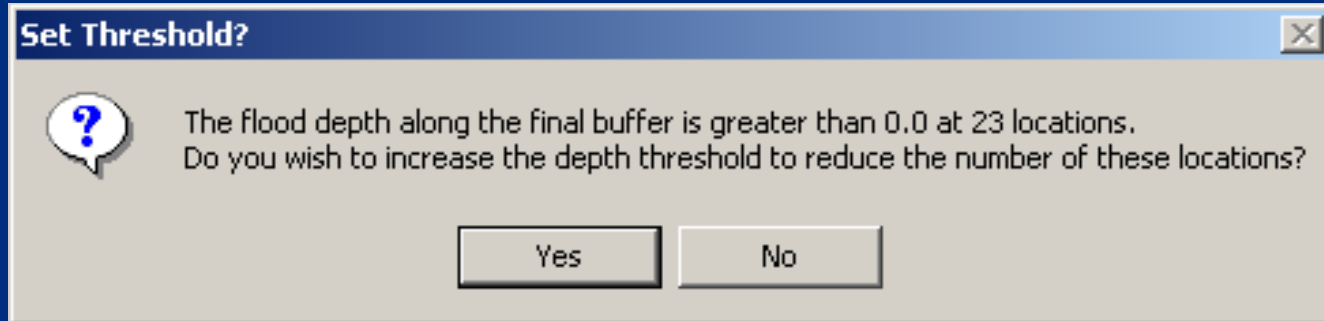
# Depth Grid Wizard

## Possible Threshold 'Errors'

Option 1: Increase the Center line buffer.

Option 2: Increase Depth Threshold.

Option 3: Leave as is and continue.





# Backwater Analysis

Identifies non-conveyance areas (ponds) of flooding

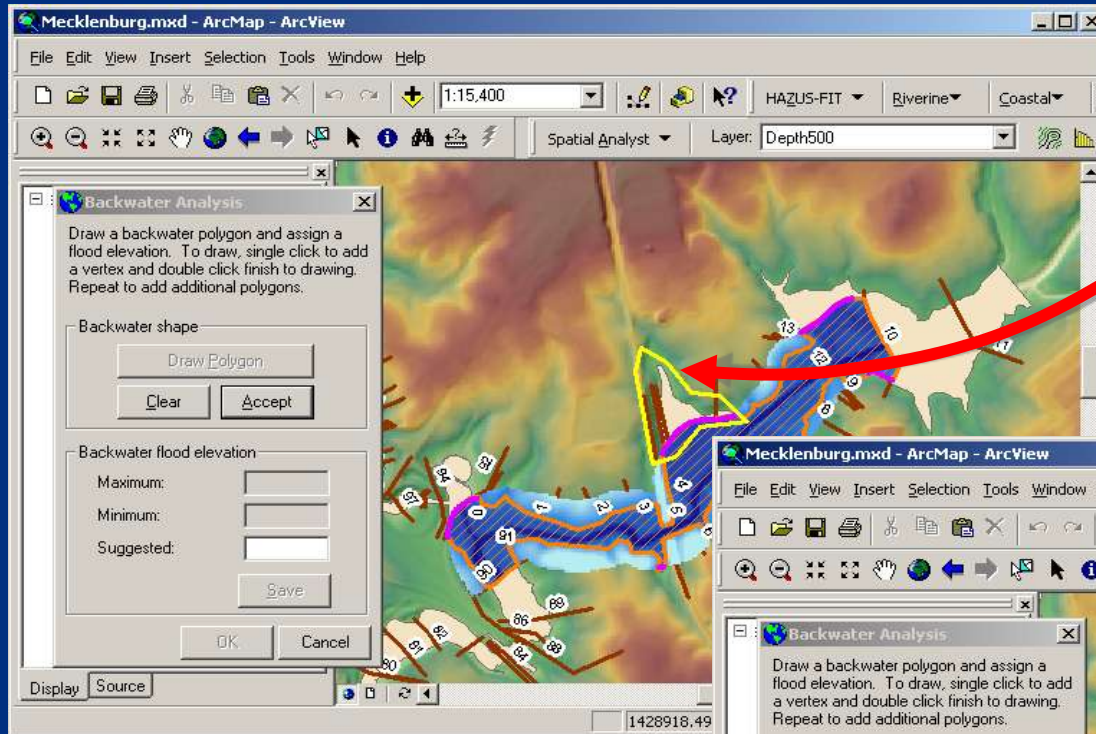
Establishes flood elevations for non-conveyance areas

Adjusts the flood elevation and depth grids to include backwater areas

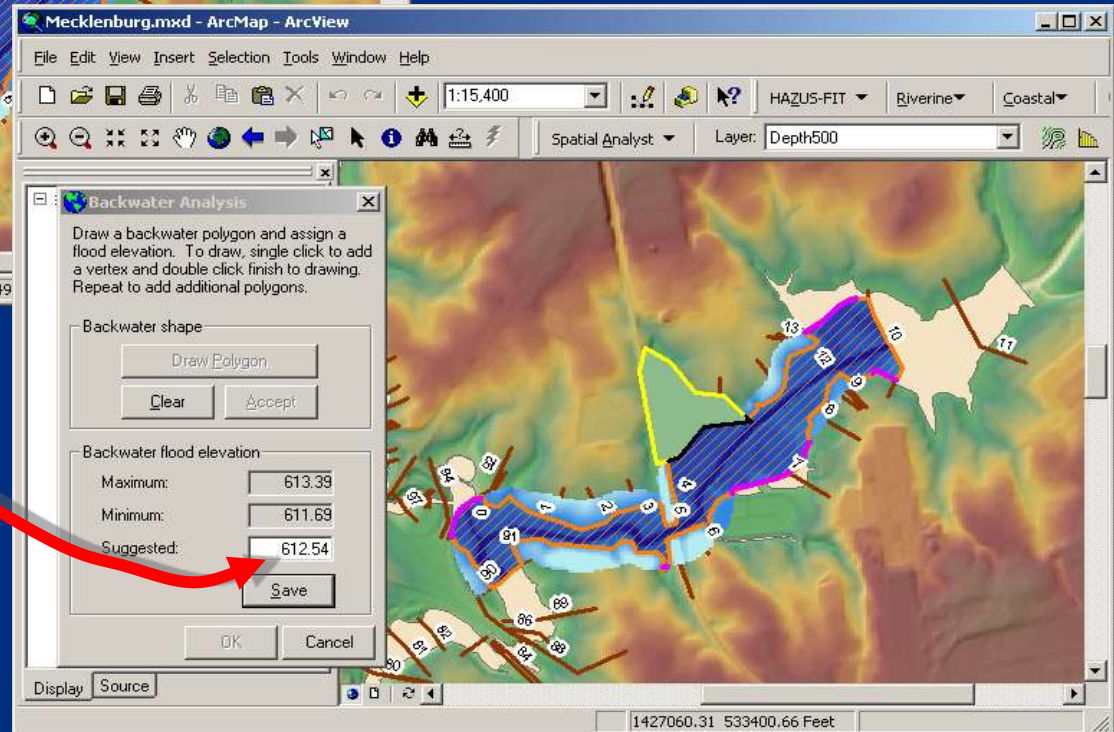


# Backwater Analysis

1. Draw backwater polygon.



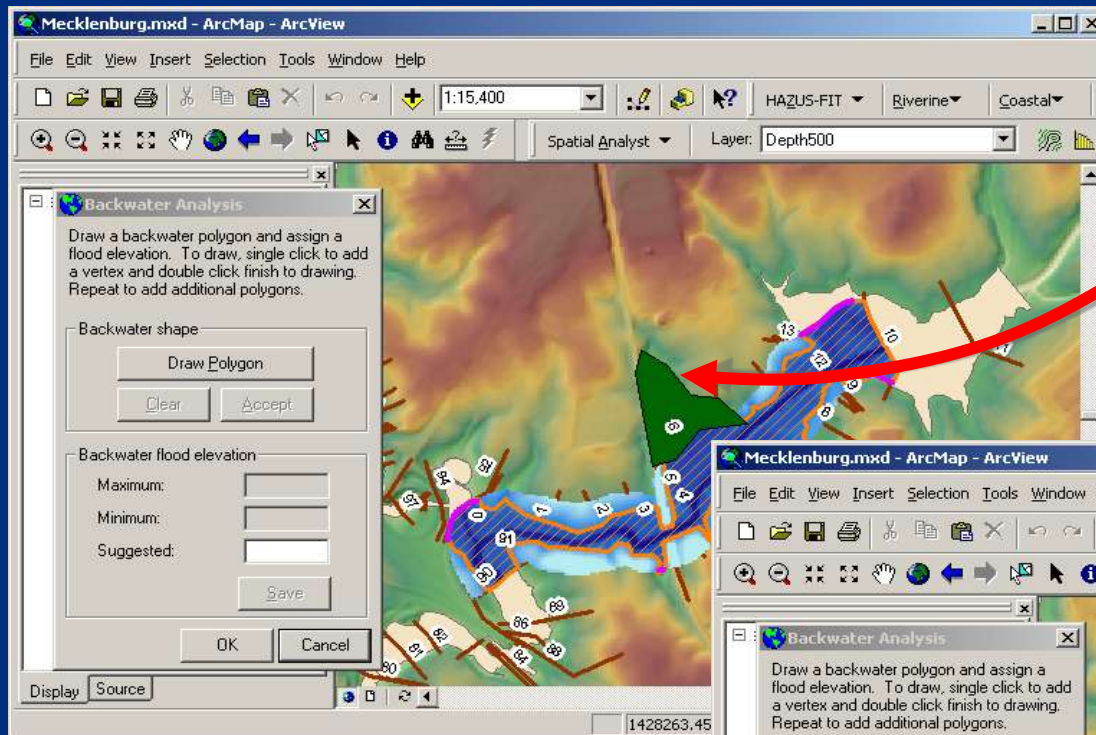
2. Accept suggested flood elevation or enter your own.



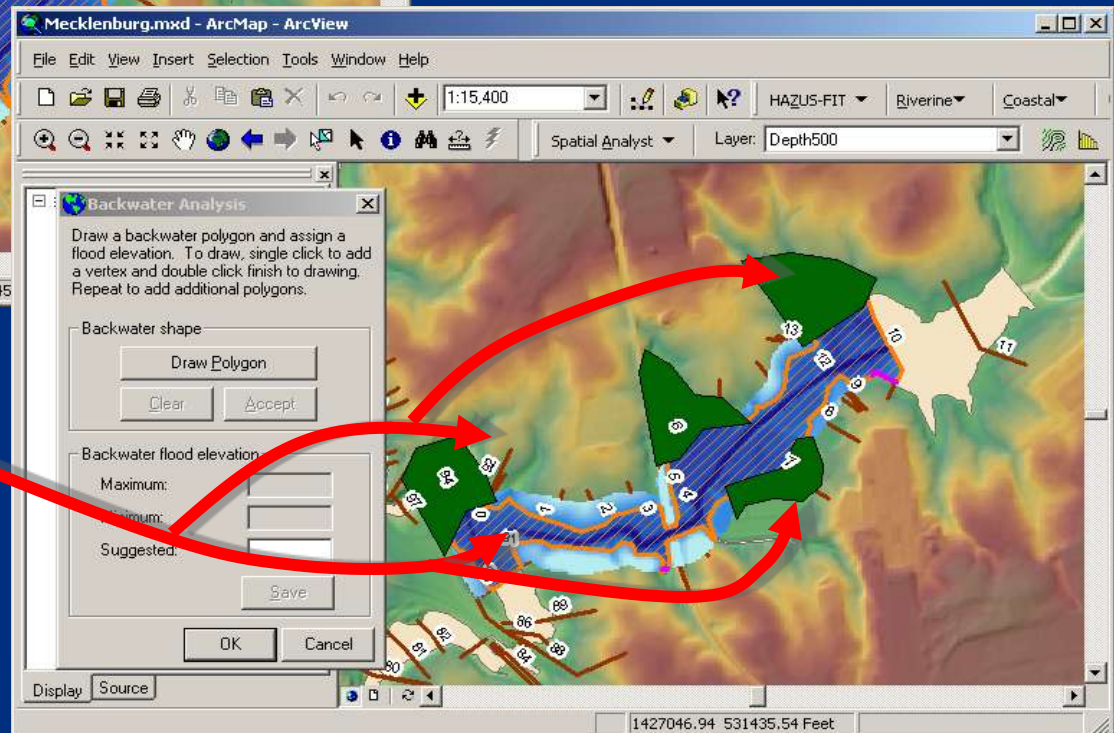


# Backwater Analysis

3. Save the backwater polygon



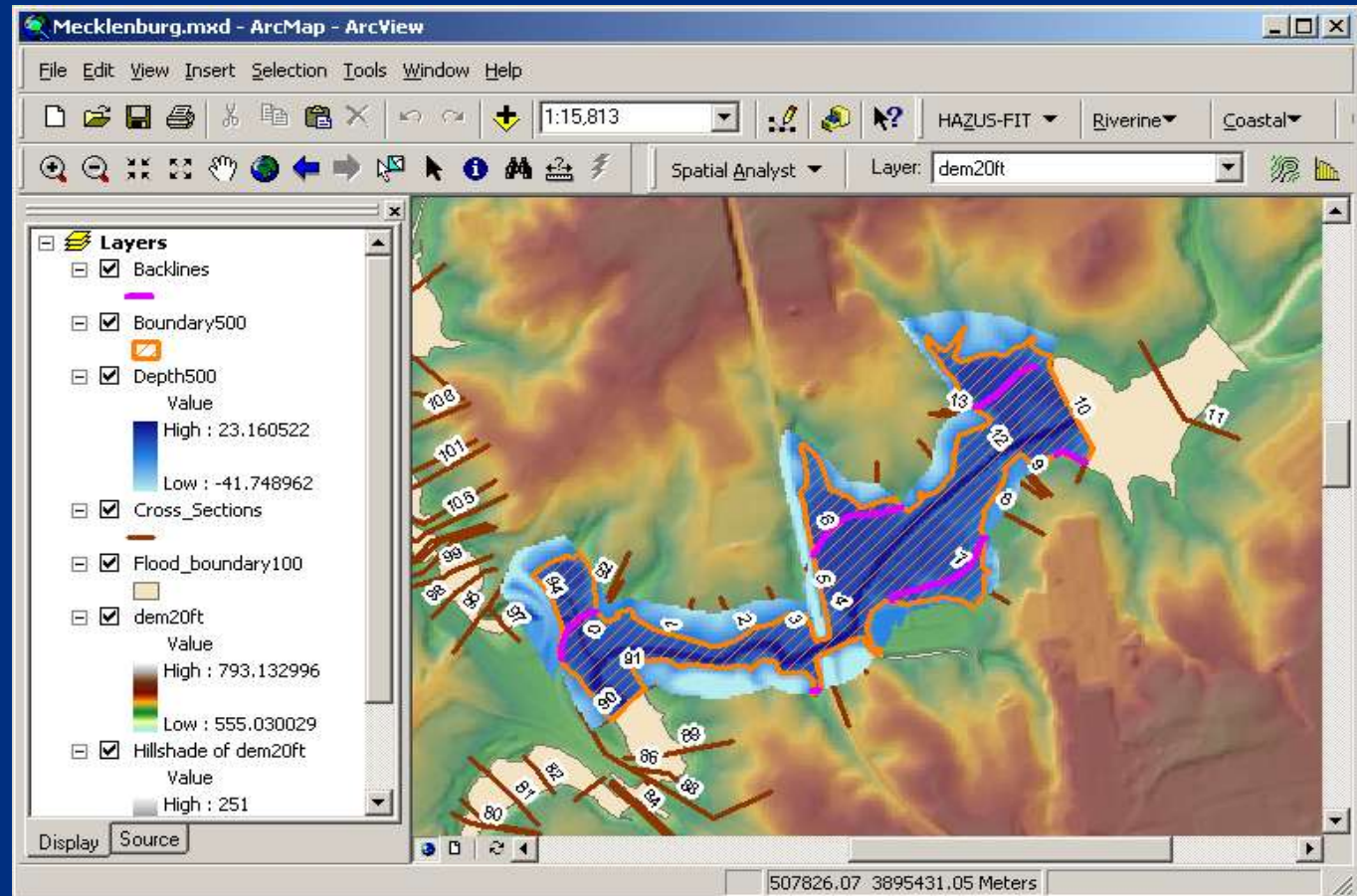
4. Add additional polygons (optional)





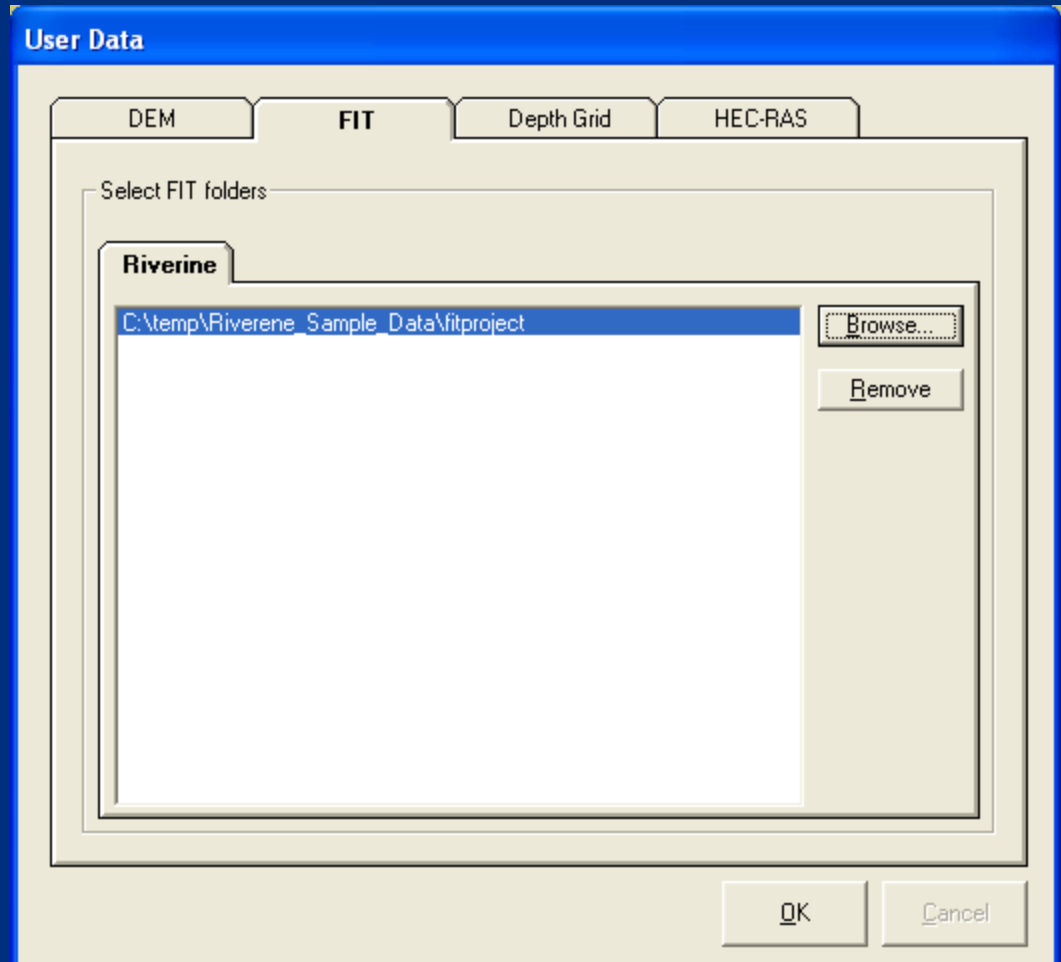
# Backwater Analysis

## Results



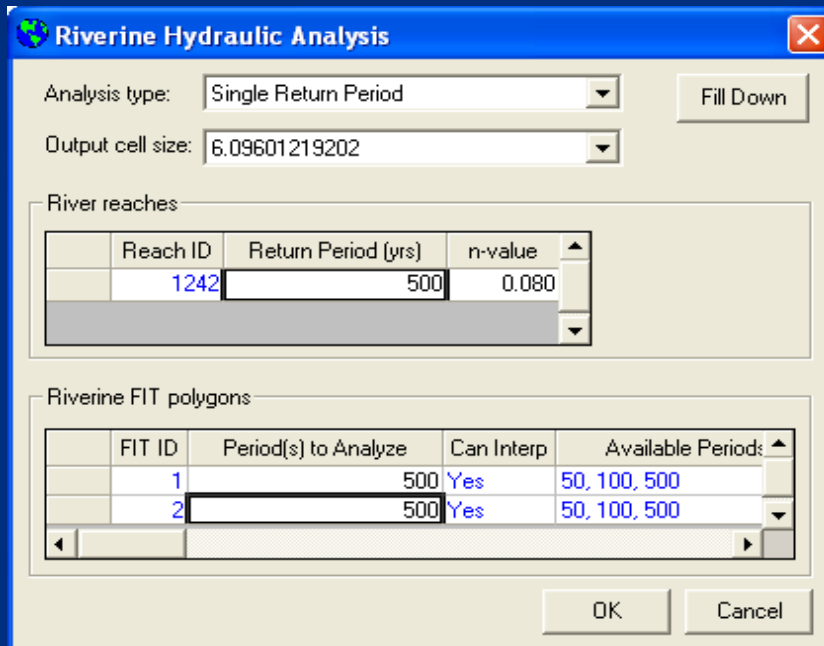
# Import to HAZUS-MH

1. Click on the Hazard\User Data menu item and click the FIT tab.
2. Browse for the location of the FIT project(s) that you want to use.



# Import to HAZUS-MH

3. In New Scenario, use the FIT analysis areas radio button.
4. Compute hydraulics.



**Riverine Hydraulic Analysis**

Analysis type:

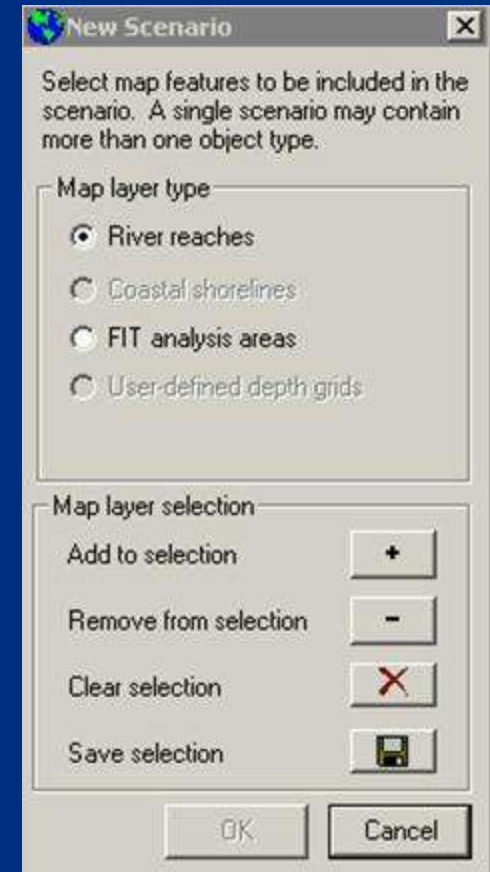
Output cell size:

River reaches

Reach ID	Return Period (yrs)	n-value
1242	500	0.080

Riverine FIT polygons

FIT ID	Period(s) to Analyze	Can Interp	Available Periods
1	500	Yes	50, 100, 500
2	500	Yes	50, 100, 500



**New Scenario**

Select map features to be included in the scenario. A single scenario may contain more than one object type.

Map layer type

☒ River reaches

☐ Coastal shorelines

☐ FIT analysis areas

☐ User-defined depth grids

Map layer selection

Add to selection

Remove from selection

Clear selection

Save selection

# Additional User Provided Hazard Options



FEMA

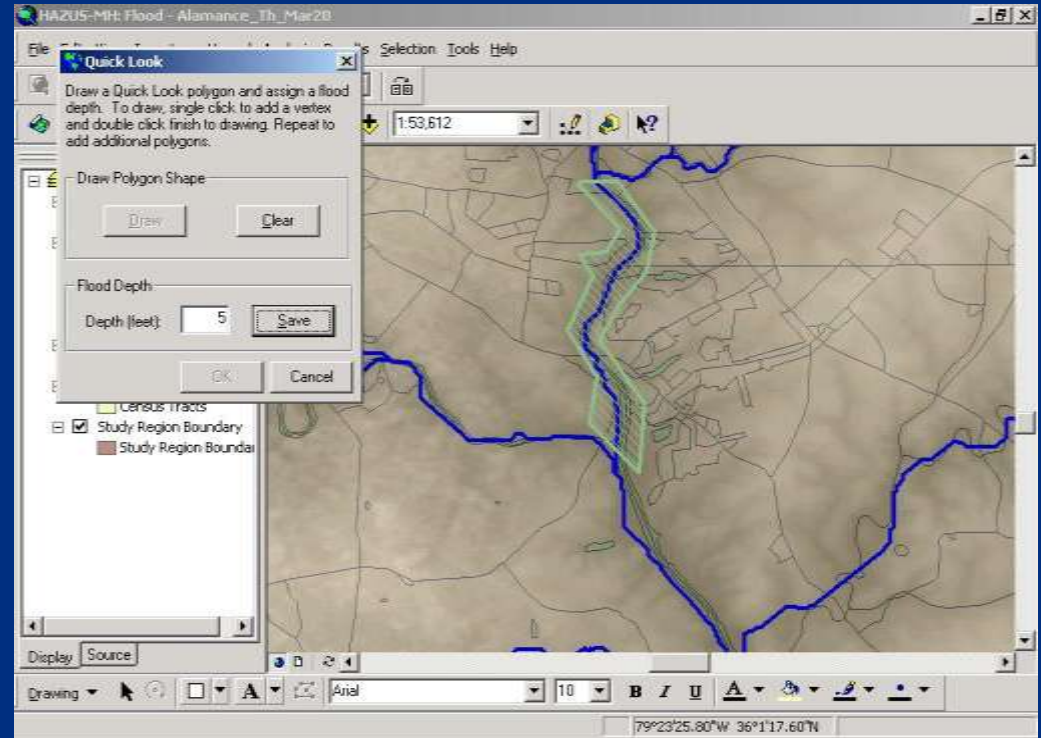
# Quick Look Feature

Allows user to estimate damage without running hydrology and hydraulics analysis.

User creates flood boundary and enters flood depth.

Estimates general building stock damage assuming uniform flood depth within polygon.

No DEM input is required.



Note: This feature can only be used in a study region in which no scenarios are open.

# Quick Look Analysis

The Quick Look and the Enhanced Quick Look analysis are both run by selecting Quick Analysis.

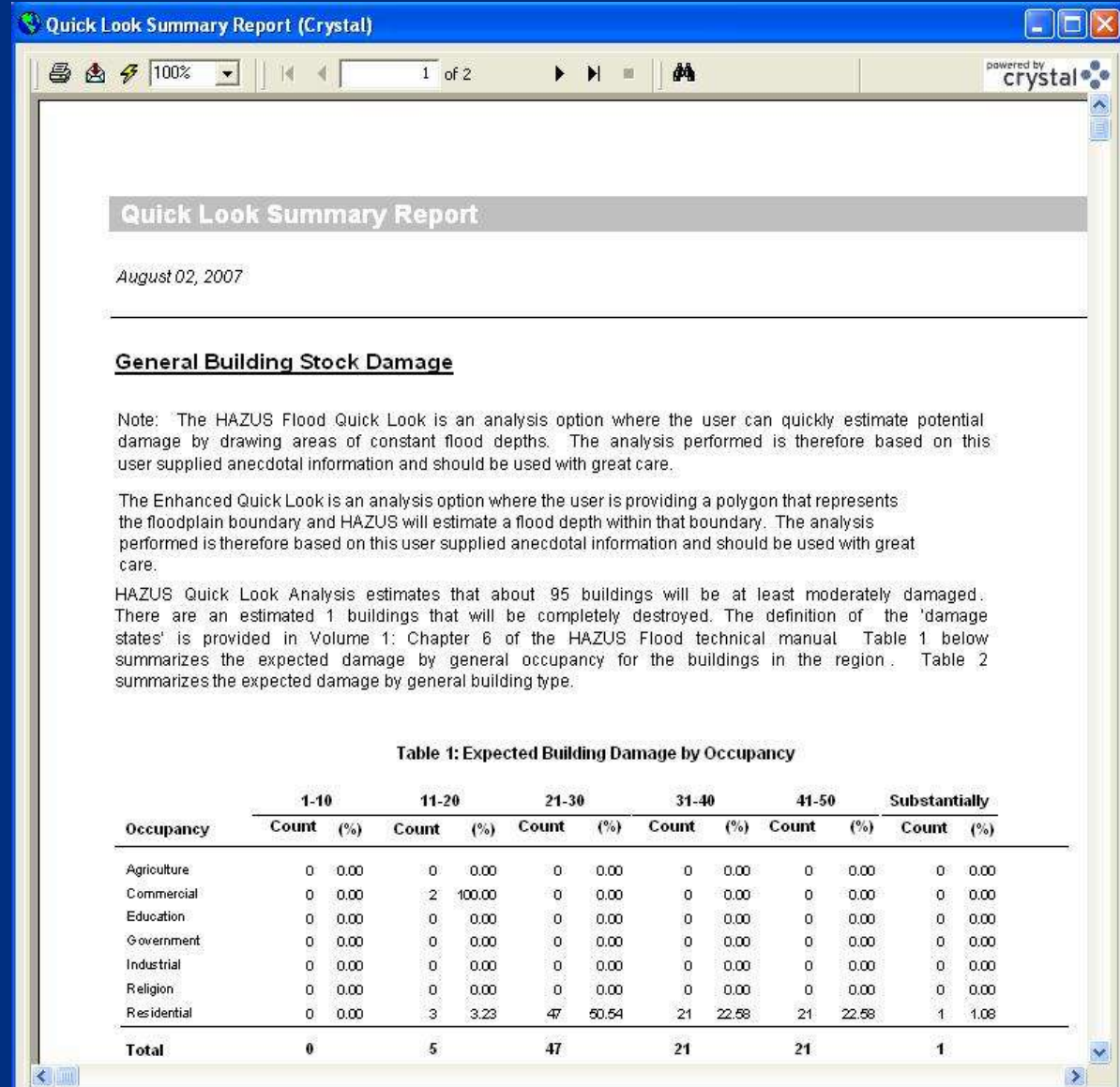
Only general building stock is analyzed, so no options exist for which analysis components to run.



# Quick Look Results

Both the Quick Look and Enhanced Quick Look tools generate a single report.

Only general building stock damage is reported.



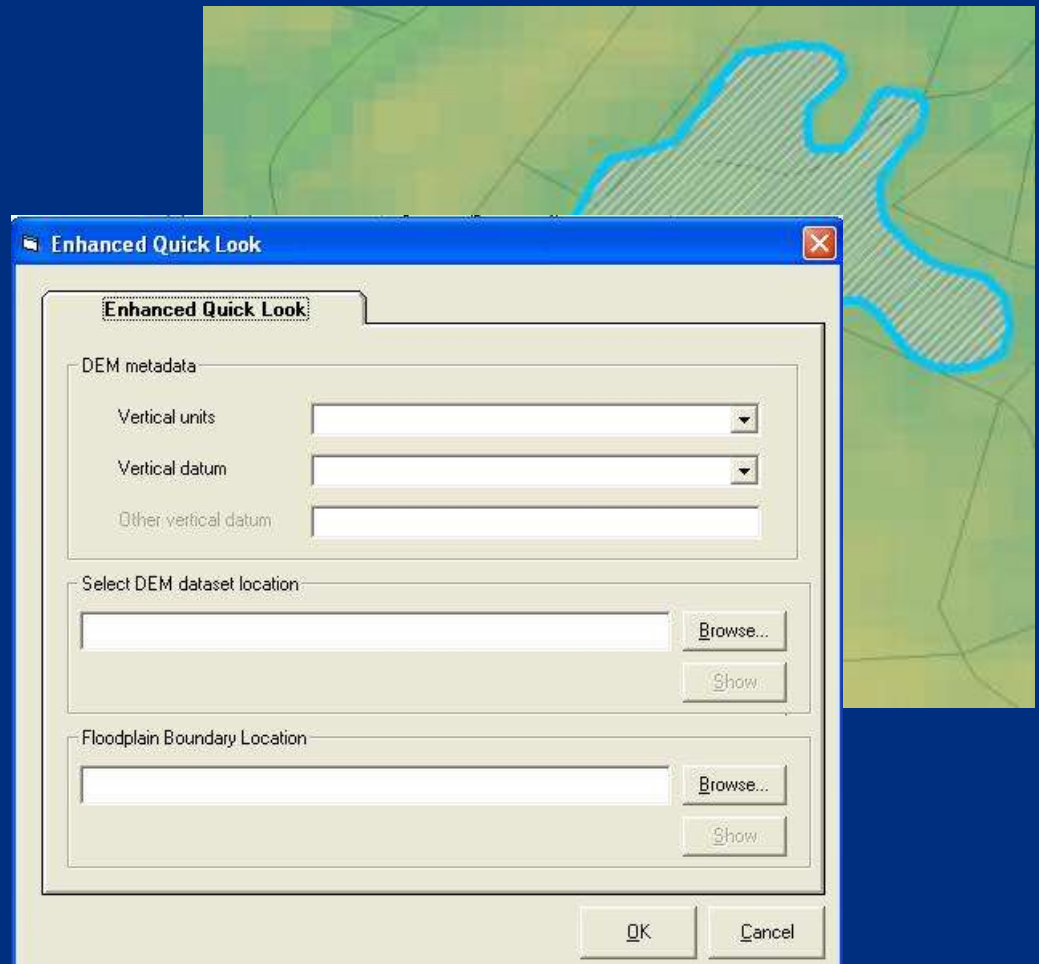


# Enhanced Quick Look

User supplies both a DEM and a flood boundary.

HAZUS-MH creates a depth grid within the boundary and estimates general building stock building damage.

**Note:** This feature can only be used in a study region in which no scenarios are open.



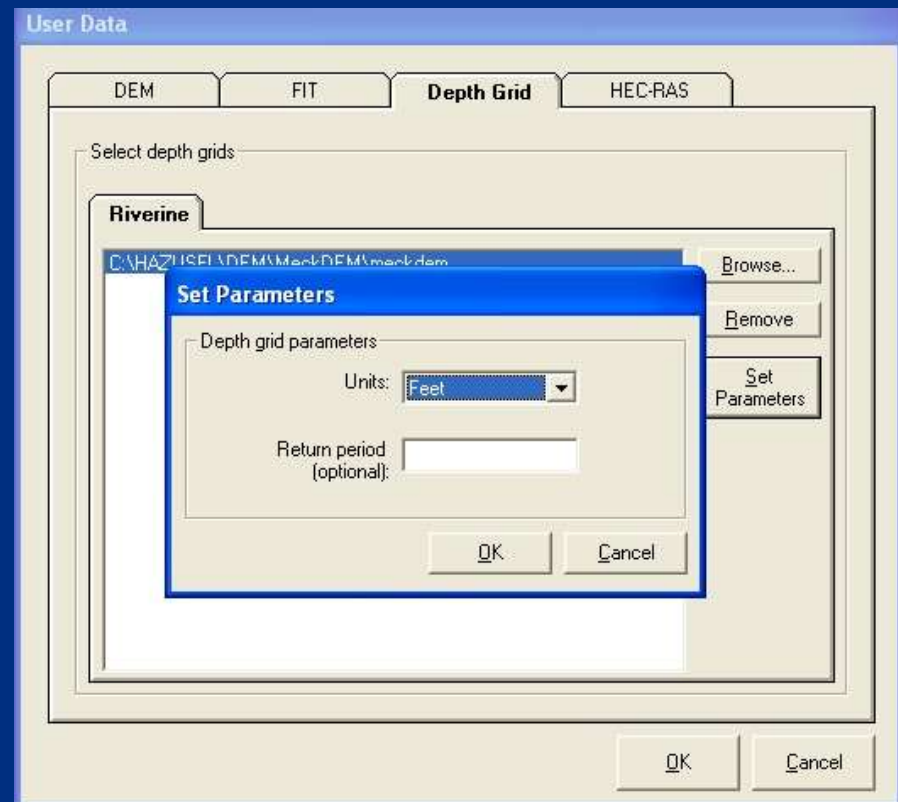


# User Defined Flood Depth Grid

HAZUS-MH allows users to point to one or more existing flood depth grids.

- Must use ArcInfo GRID format
- Depth units are defined by user
- Can use any projected coordinate system

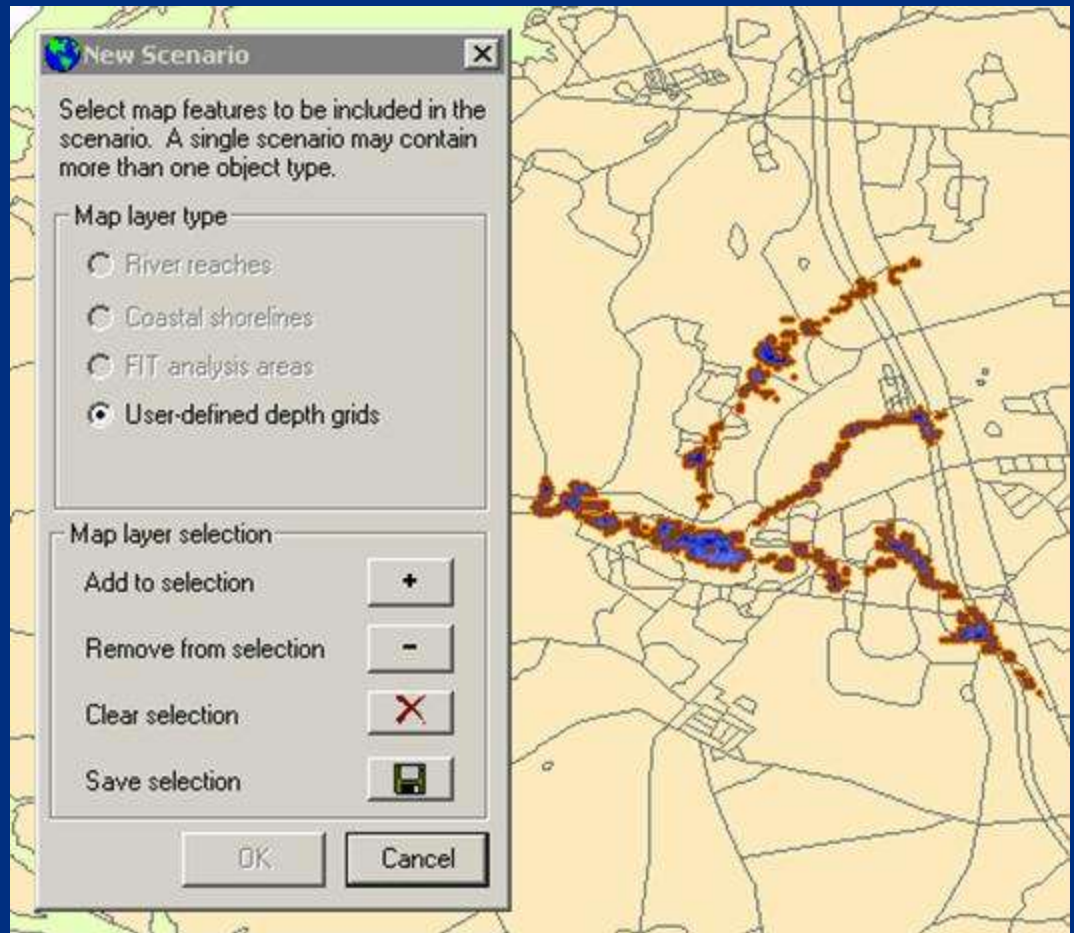
This option represents the most accurate representation of a flood hazard assuming that the depth grid has been created with appropriate methods.



# User Defined Flood Depth Grid

Assign the depth grid, along with relevant FIT areas or reaches, to a scenario.

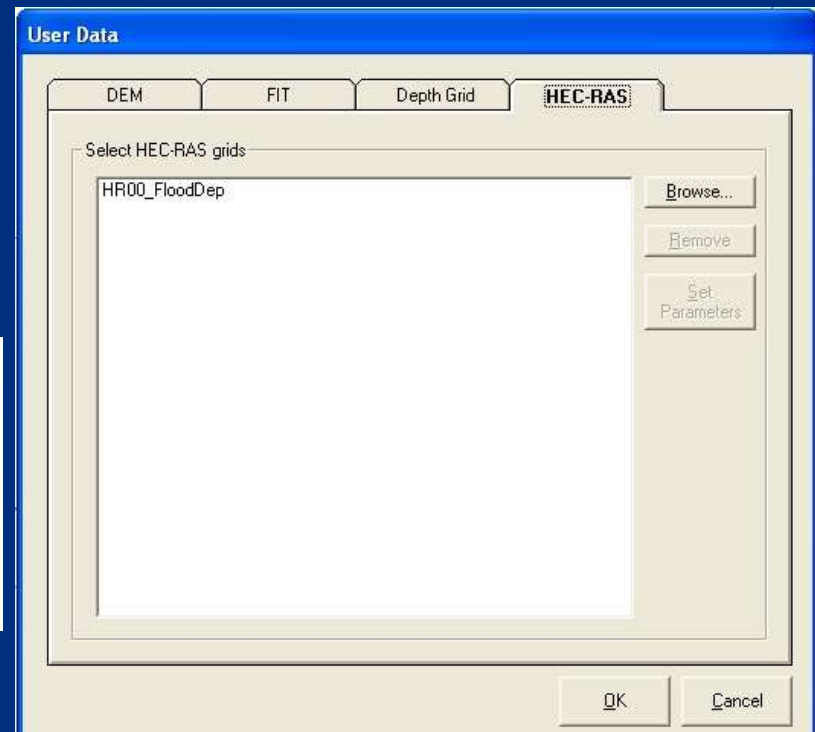
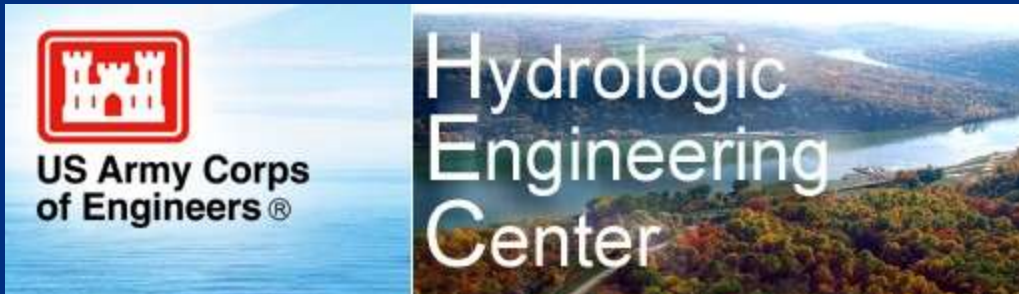
All analysis output options available.



# HEC-RAS Depth Grids

HEC-RAS (Hydrologic Engineering Center's River Analysis System) is a software package from the US Army Corps of Engineers that enables users to perform one-dimensional hydraulic calculations.

HAZUS-MH can use HEC-RAS output for enhanced dam or levee analysis.



# HEC-RAS Depth Grids

HAZUS-MH integrate HEC-RAS output in version 4.1 or later of HEC-RAS.

The floating-point binary (.flt) file is the file that you need to import into HAZUS-MH.

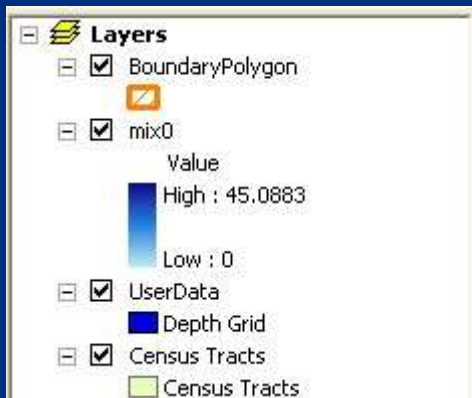


Name	Size	Type	Date Modified
FloodDepth0.flt	44,473 KB	FLT File	10/2/2009 4:08 PM
FloodDepth0.hdr	1 KB	HDR File	10/2/2009 4:08 PM
FloodMap.dbf	1 KB	DBF File	10/2/2009 4:08 PM
FloodMap.prj	1 KB	PRJ File	10/2/2009 4:08 PM
FloodMap.shp	760 KB	SHP File	10/2/2009 4:08 PM
FloodMap.shx	1 KB	SHX File	10/2/2009 4:08 PM

# HEC-RAS Depth Grids

Output will show flood boundaries.

Important: HAZUS-MH only computes still water damages. Damages related to velocity from a dam or levee break is not calculated.





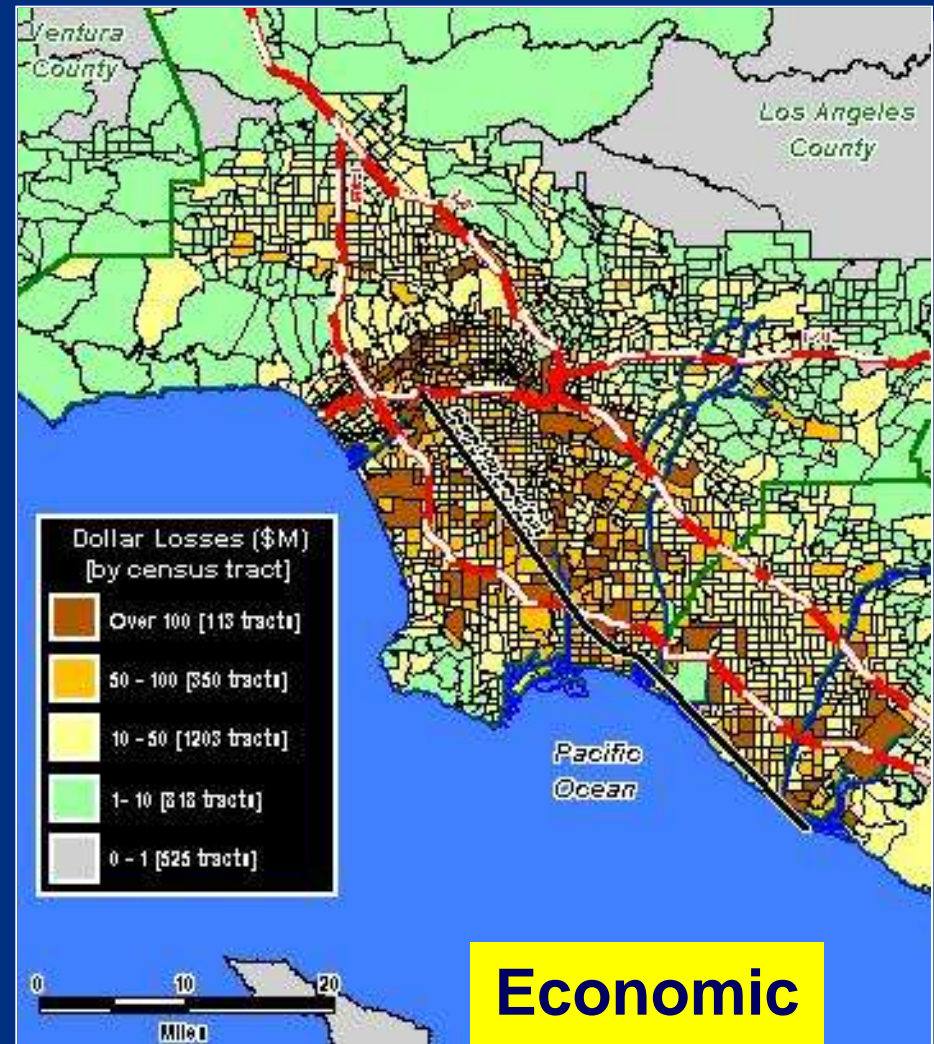
# HAZUS-MH Output



**Physical  
Impacts**



**Social  
Impacts**



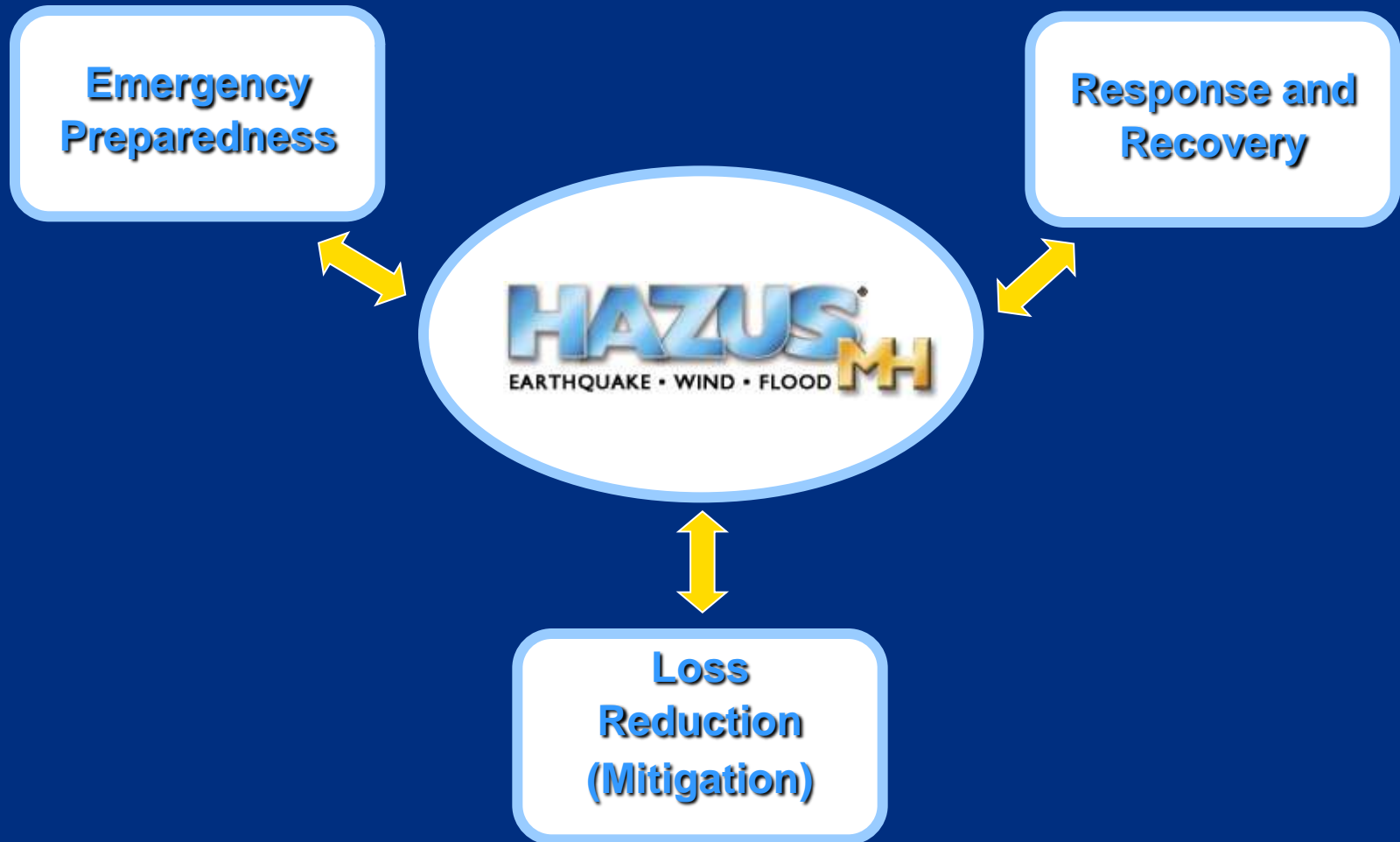
**Economic  
Impacts**



# HAZUS-MH Output

		Earthquake Ground Shaking Ground Failure	Flood Frequency Depth Discharge Velocity	Hurricane Wind Pressure   Missile   Rain
➤ Direct Damage				
General Building Stock	✓	✓	✓	
Essential Facilities	✓	✓	✓	
High Potential Loss Facilities	✓			
Transportation Systems	✓	✓		
Utility Systems	✓	✓		
➤ Induced Damage				
Fire Following	✓			
Hazardous Materials Release	✓			
Debris Generation	✓	✓	✓	
➤ Direct Losses				
Cost of Repair	✓	✓	✓	
Income Loss	✓	✓	✓	
Crop Damage		✓		
Casualties	✓	Generic Output		
Shelter Needs	✓		✓	
➤ Indirect Losses				
Supply Shortages	✓	✓		
Sales Decline	✓	✓		
Opportunity Costs	✓	✓		
Economic Loss	✓	✓		

# HAZUS-MH in Emergency Management



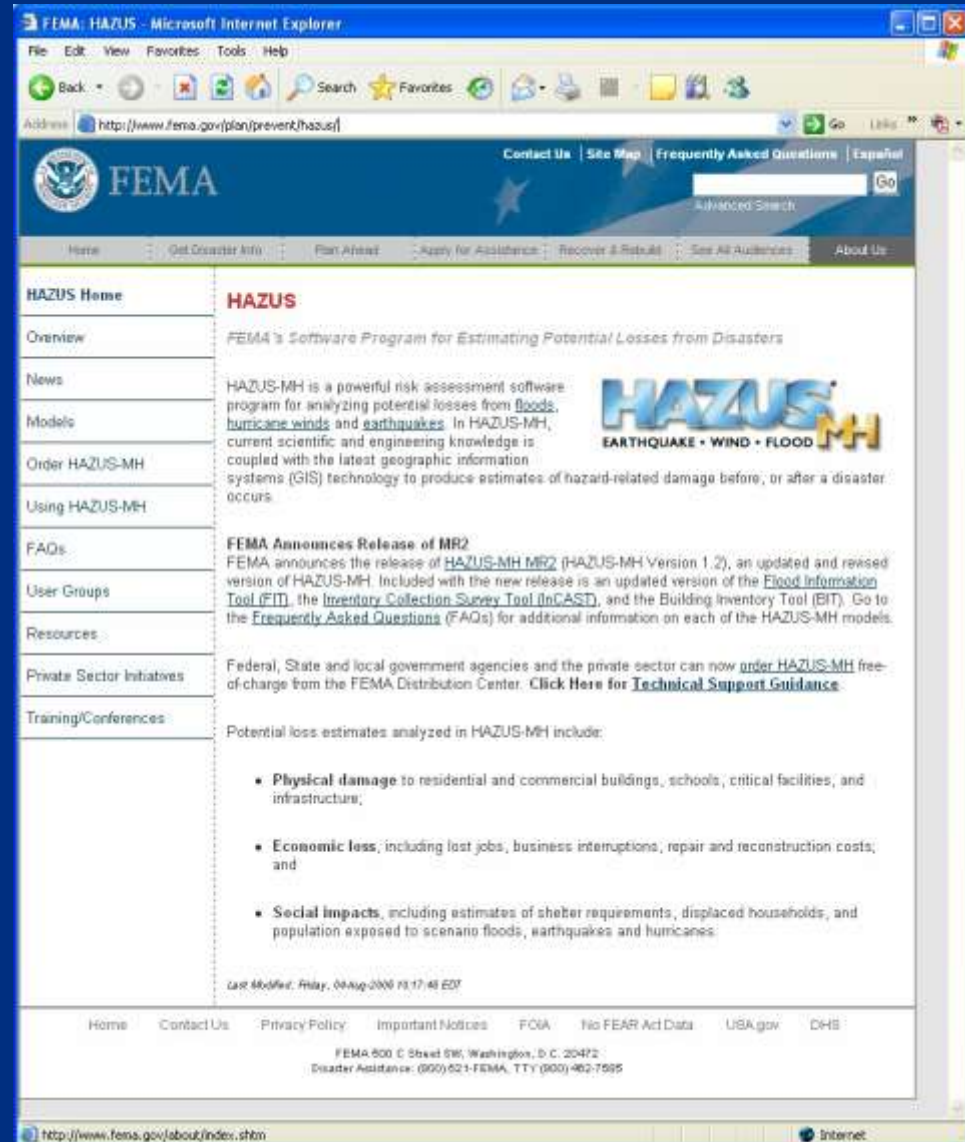
# FEMA Resources

HAZUS-MH Overview

Software Order Forms

Training / Conference  
Information

FAQs




<http://www.fema.gov/plan/prevent/hazus/>

# User Groups


Latest news

User feedback

User group contacts




Supporting the HAZUS user community across the country, the ultimate on-line resource for everything HAZUS ...




About HAZUS.org	FEMA HAZUS Web Pages	HAZUS.org Resources	Contact HAZUS.org	HAZUS.org Affiliates
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- ▶ Join HAZUS.org
- ▶ HAZUS User Groups
- ▶ HAZUS Training & Technical Assistance
- ▶ HAZUS.org Special Interest Groups
- ▶ HAZUS Success Stories



**The National HAZUS User Conference will be held concurrent with the 2007 ESRI International User Conference.**

For more info and to see how you can participate, [▶ click here...](#)



**FEMA HAZUS User of the Month...**


As a way of recognizing those individuals who are dedicated to furthering the success of HAZUS, FEMA has created the HAZUS User of the Month designation to help show appreciation to those who have contributed to the success of the program. For more info and to download the nomination form ▶

**Breaking News...**


- ▶ Institute on Disabilities and the Center of Preparedness, Education and Practice at Temple University announce the establishment of a listserv and web site for Special Populations Analysis and Research with GIS (SPAR-GIS). For more info, [▶click here...](#)
- ▶ Western Disaster Center and Jamie Caplan Consulting team to develop and promote HAZUS.org. For more info, [▶click here...](#)
- ▶ Are We Ready? The Public Readiness Index: A Survey-Based Tool to Measure the Preparedness of Individuals, Families and Communities. To download the report, [▶click here](#). To read more about this research, [▶click here](#).

**Upcoming Events...**

- ▶ Congressional Hazards Caucus Alliance briefing and panel discussion - End-To-End Disaster Communications. Thurs / Feb 8, 2007, Rayburn Building, Washington DC. For more info, [▶ click here...](#)
- ▶ HUG Leaders Conference Call; Tuesday / Feb 20, 2007 / 4:00 PM EST.



To view the complete HAZUS.org News & Events Summary, [▶click here...](#)



Please send us your suggestions and updates on news & events of interest to the HAZUS user community, [▶click](#)

<http://www.hazus.org/>

# HAZUS-MH Local Training

## HAZUS Multi-Hazards for Floods Course

L172

Register online at  
<https://ks.train.org>  
Search for  
Course ID: 1020150

Participants can register on KS-TRAIN. If you need assistance or help starting a user account, please call Isabel Herrera Schultes at [isabel.herrera@tag.ks.gov](mailto:isabel.herrera@tag.ks.gov) or 785-274-1412 or contact the KS-TRAIN Help Desk at [helpdesk@kah.state.ks.us](mailto:helpdesk@kah.state.ks.us) or 785-296-5655.

Contact Jessica Frye at [jessica.frye@tag.ks.gov](mailto:jessica.frye@tag.ks.gov) or 785-274-1610 with questions about the course or concerns about lodging reimbursements.



Kansas Emergency Management  
Training Office  
Isabel Herrera Schultes  
[isabel.herrera@tag.ks.gov](mailto:isabel.herrera@tag.ks.gov)  
P 785-274-1412—F 785-274-1914

Topeka, Kansas  
March 22-25, 2010

This course provides in-depth instructions and hands-on exercises that develop the skills needed to effectively use HAZUS-MH for modeling the impacts on communities from riverine and coastal flooding. The focus of the course is on the processes that are used to define a flood hazard and to generate social and economic loss estimations. However, the course also provides a review of the methodologies used to compile the extensive out-of-the-box inventory that is provided with HAZUS and it provides an introduction to the techniques for updating the inventory, which is largely composed of best available national data sources, with more accurate aggregate and site specific local data.

### Target Audience

FEMA, State and local government employees involved with or interested in planning for emergencies associated with flooding, earthquake or hurricane events. This includes, researchers, insurance and utility companies.

### Prerequisites

**Required:** basic familiarity with ArcGIS and an understanding of basic concepts related to emergency management. **Recommended:** ESRI on-line GIS Tutorial and Introduction to ArcView 9.x

This course is sponsored by E&E Consultants, AECOM, The Kansas Adjutant General's Department, Heartland HUG, and FEMA Region VII

The deadline to register is two weeks before the course starts (Mar. 5, 2010).

Lodging reimbursements will be available for those traveling 60 miles or more (up to 2 nights).

# Contact Information

President of the Heartland Hazus Users Group

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Heartland HAZUS Users Group and Training



# Questions?